

SUMMARY

1. Real assets create wealth. Financial assets represent claims to parts or all of that wealth. Financial assets determine how the ownership of real assets is distributed among investors.
2. Financial assets can be categorized as fixed income, equity, or derivative instruments. Top-down portfolio construction techniques start with the asset allocation decision—the allocation of funds across broad asset classes—and then progress to more specific security-selection decisions.
3. Competition in financial markets leads to a risk–return trade-off, in which securities that offer higher expected rates of return also impose greater risks on investors. The presence of risk, however, implies that actual returns can differ considerably from expected returns at the beginning of the investment period. Competition among security analysts also promotes financial markets that are nearly informationally efficient, meaning that prices reflect all available information concerning the value of the security. Passive investment strategies may make sense in nearly efficient markets.
4. Financial intermediaries pool investor funds and invest them. Their services are in demand because small investors cannot efficiently gather information, diversify, and monitor portfolios. The financial intermediary sells its own securities to the small investors. The intermediary invests the funds thus raised, uses the proceeds to pay back the small investors, and profits from the difference (the spread).
5. Investment banking brings efficiency to corporate fund-raising. Investment bankers develop expertise in pricing new issues and in marketing them to investors. By the end of 2008, all the major stand-alone U.S. investment banks had been absorbed into commercial banks or had reorganized themselves into bank holding companies. In Europe, where universal banking had never been prohibited, large banks had long maintained both commercial and investment banking divisions.
6. The financial crisis of 2008 showed the importance of systemic risk. Policies that limit this risk include transparency to allow traders and investors to assess the risk of their counterparties, capital adequacy to prevent trading participants from being brought down by potential losses, frequent settlement of gains or losses to prevent losses from accumulating beyond an institution's ability to bear them, incentives to discourage excessive risk taking, and accurate and unbiased risk assessment by those charged with evaluating security risk.

Related Web sites for this chapter are available at www.mhhe.com/bkm

KEY TERMS

investment	asset allocation	investment companies
real assets	security selection	investment bankers
financial assets	security analysis	primary market
fixed-income (debt) securities	risk–return trade-off	secondary market
equity	passive management	securitization
derivative securities	active management	systemic risk
agency problem	financial intermediaries	

PROBLEM SETS

i. Basic

1. Financial engineering has been disparaged as nothing more than paper shuffling. Critics argue that resources used for *rearranging* wealth (that is, bundling and unbundling financial assets) might be better spent on *creating* wealth (that is, creating real assets). Evaluate this criticism. Are any benefits realized by creating an array of derivative securities from various primary securities?
2. Why would you expect securitization to take place only in highly developed capital markets?
3. What is the relationship between securitization and the role of financial intermediaries in the economy? What happens to financial intermediaries as securitization progresses?

4. Although we stated that real assets comprise the true productive capacity of an economy, it is hard to conceive of a modern economy without well-developed financial markets and security types. How would the productive capacity of the U.S. economy be affected if there were no markets in which one could trade financial assets?
5. Firms raise capital from investors by issuing shares in the primary markets. Does this imply that corporate financial managers can ignore trading of previously issued shares in the secondary market?
6. Suppose housing prices across the world double.
 - a. Is society any richer for the change?
 - b. Are homeowners wealthier?
 - c. Can you reconcile your answers to (a) and (b)? Is anyone worse off as a result of the change?
7. Lanni Products is a start-up computer software development firm. It currently owns computer equipment worth \$30,000 and has cash on hand of \$20,000 contributed by Lanni's owners. For each of the following transactions, identify the real and/or financial assets that trade hands. Are any financial assets created or destroyed in the transaction?
 - a. Lanni takes out a bank loan. It receives \$50,000 in cash and signs a note promising to pay back the loan over 3 years.
 - b. Lanni uses the cash from the bank plus \$20,000 of its own funds to finance the development of new financial planning software.
 - c. Lanni sells the software product to Microsoft, which will market it to the public under the Microsoft name. Lanni accepts payment in the form of 1,500 shares of Microsoft stock.
 - d. Lanni sells the shares of stock for \$80 per share and uses part of the proceeds to pay off the bank loan.
8. Reconsider Lanni Products from the previous problem.
 - a. Prepare its balance sheet just after it gets the bank loan. What is the ratio of real assets to total assets?
 - b. Prepare the balance sheet after Lanni spends the \$70,000 to develop its software product. What is the ratio of real assets to total assets?
 - c. Prepare the balance sheet after Lanni accepts the payment of shares from Microsoft. What is the ratio of real assets to total assets?
9. Examine the balance sheet of commercial banks in Table 1.3. What is the ratio of real assets to total assets? What is that ratio for nonfinancial firms (Table 1.4)? Why should this difference be expected?
10. Consider Figure 1.5, which describes an issue of American gold certificates.
 - a. Is this issue a primary or secondary market transaction?
 - b. Are the certificates primitive or derivative assets?
 - c. What market niche is filled by this offering?
11. Discuss the advantages and disadvantages of the following forms of managerial compensation in terms of mitigating agency problems, that is, potential conflicts of interest between managers and shareholders.
 - a. A fixed salary.
 - b. Stock in the firm that must be held for five years.
 - c. A salary linked to the firm's profits.

ii. Intermediate

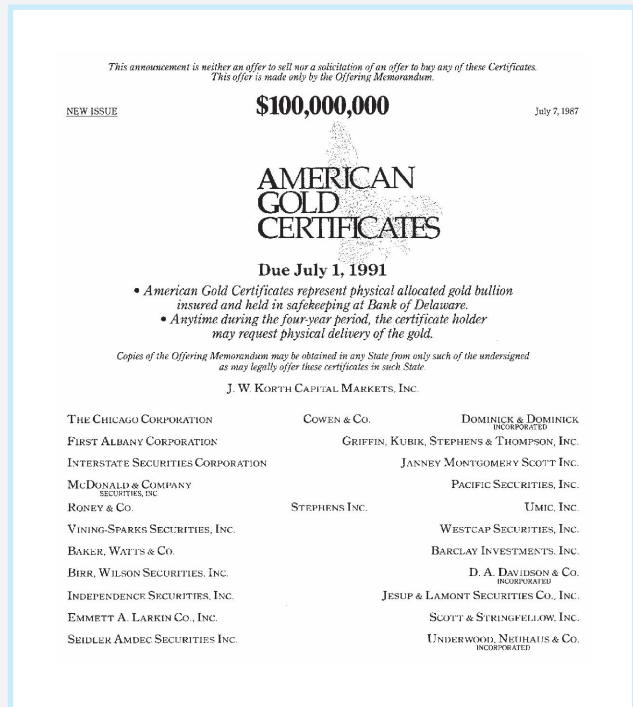


Figure 1.5 A gold-backed security

12. We noted that oversight by large institutional investors or creditors is one mechanism to reduce agency problems. Why don't individual investors in the firm have the same incentive to keep an eye on management?
13. Give an example of three financial intermediaries and explain how they act as a bridge between small investors and large capital markets or corporations.
14. The average rate of return on investments in large stocks has outpaced that on investments in Treasury bills by about 7% since 1926. Why, then, does anyone invest in Treasury bills?
15. What are some advantages and disadvantages of top-down versus bottom-up investing styles?
16. You see an advertisement for a book that claims to show how you can make \$1 million with no risk and with no money down. Will you buy the book?
17. Why do financial assets show up as a component of household wealth, but not of national wealth? Why do financial assets still matter for the material well-being of an economy?
18. Wall Street firms have traditionally compensated their traders with a share of the trading profits that they generated. How might this practice have affected traders' willingness to assume risk? What is the agency problem this practice engendered?
19. What reforms to the financial system might reduce its exposure to systemic risk?

E-INVESTMENTS EXERCISES

Market Regulators

1. Go to the Securities and Exchange Commission Web site, www.sec.gov. What is the mission of the SEC? What information and advice does the SEC offer to beginning investors?
2. Go to the NASD Web site, www.finra.org. What is its mission? What information and advice does it offer to beginners?
3. Go to the IOSCO Web site, www.iosco.org. What is its mission? What information and advice does it offer to beginners?

SOLUTIONS TO CONCEPT CHECKS

1.
 - a. Real
 - b. Financial
 - c. Real
 - d. Real
 - e. Financial
2. The central issue is the incentive to monitor the quality of loans when originated as well as over time. Freddie and Fannie clearly had incentive to monitor the quality of conforming loans that they had guaranteed, and their ongoing relationships with mortgage originators gave them opportunities to evaluate track records over extended periods of time. In the subprime mortgage market, the ultimate investors in the securities (or the CDOs backed by those securities), who were bearing the credit risk, should not have been willing to invest in loans with a disproportionate likelihood of default. If they properly understood their exposure to default risk, then the (correspondingly low) prices they would have been willing to pay for these securities would have imposed discipline on the mortgage originators and servicers. The fact that they were willing to hold such large positions in these risky securities suggests that they did not appreciate the extent

of their exposure. Maybe they were led astray by overly optimistic projections for housing prices or by biased assessments from the credit reporting agencies. In principle, either arrangement for default risk could have provided the appropriate discipline on the mortgage originators; in practice, however, the informational advantages of Freddie and Fannie probably made them the better “recipients” of default risk. The lesson is that information and transparency are some of the preconditions for well-functioning markets.

SUMMARY

1. Money market securities are very short-term debt obligations. They are usually highly marketable and have relatively low credit risk. Their low maturities and low credit risk ensure minimal capital gains or losses. These securities trade in large denominations, but they may be purchased indirectly through money market funds.
2. Much of U.S. government borrowing is in the form of Treasury bonds and notes. These are coupon-paying bonds usually issued at or near par value. Treasury notes and bonds are similar in design to coupon-paying corporate bonds.
3. Municipal bonds are distinguished largely by their tax-exempt status. Interest payments (but not capital gains) on these securities are exempt from federal income taxes. The equivalent taxable yield offered by a municipal bond equals $r_m/(1 - t)$, where r_m is the municipal yield and t is the investor's tax bracket.
4. Mortgage pass-through securities are pools of mortgages sold in one package. Owners of pass-throughs receive the principal and interest payments made by the borrowers. The originator that issued the mortgage merely services it, simply "passing through" the payments to the purchasers of the mortgage. A federal agency may guarantee the payment of interest and principal on mortgages pooled into its pass-through securities, but these guarantees are absent in private-label pass-throughs.
5. Common stock is an ownership share in a corporation. Each share entitles its owner to one vote on matters of corporate governance and to a prorated share of the dividends paid to shareholders. Stock, or equity, owners are the residual claimants on the income earned by the firm.
6. Preferred stock usually pays fixed dividends for the life of the firm; it is a perpetuity. A firm's failure to pay the dividend due on preferred stock, however, does not precipitate corporate bankruptcy. Instead, unpaid dividends simply cumulate. Newer varieties of preferred stock include convertible and adjustable-rate issues.
7. Many stock market indexes measure the performance of the overall market. The Dow Jones averages, the oldest and best-known indicators, are price-weighted indexes. Today, many broad-based, market-value-weighted indexes are computed daily. These include the Standard & Poor's 500 stock index, the NYSE index, the NASDAQ index, the Wilshire 5000 index, and indexes of many non-U.S. stock markets.
8. A call option is a right to purchase an asset at a stipulated exercise price on or before an expiration date. A put option is the right to sell an asset at some exercise price. Calls increase in value while puts decrease in value as the price of the underlying asset increases.
9. A futures contract is an obligation to buy or sell an asset at a stipulated futures price on a maturity date. The long position, which commits to purchasing, gains if the asset value increases while the short position, which commits to delivering, loses.

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KEY TERMS

money market	London Interbank Offered Rate (LIBOR)	price-earnings ratio
capital markets	Treasury notes	preferred stock
asked price	Treasury bonds	price-weighted average
bid price	yield to maturity	market-value-weighted index
bid-asked spread	municipal bonds	index funds
certificate of deposit	equivalent taxable yield	derivative assets
commercial paper	equities	call option
banker's acceptance	residual claim	exercise (strike) price
Eurodollars	limited liability	put option
repurchase agreements	capital gains	futures contract
federal funds		

1. In what ways is preferred stock like long-term debt? In what ways is it like equity?
2. Why are money market securities sometimes referred to as “cash equivalents”?
3. Which of the following **correctly** describes a repurchase agreement?
 - a. The sale of a security with a commitment to repurchase the same security at a specified future date and a designated price.
 - b. The sale of a security with a commitment to repurchase the same security at a future date left unspecified, at a designated price.
 - c. The purchase of a security with a commitment to purchase more of the same security at a specified future date.
4. What would you expect to happen to the spread between yields on commercial paper and Treasury bills if the economy were to enter a steep recession?
5. What are the key differences between common stock, preferred stock, and corporate bonds?
6. Why are high-tax-bracket investors more inclined to invest in municipal bonds than low-bracket investors?
7. Turn back to Figure 2.3 and look at the Treasury bond maturing in February 2039.
 - a. How much would you have to pay to purchase one of these notes?
 - b. What is its coupon rate?
 - c. What is the current yield of the note?
8. Suppose investors can earn a return of 2% per 6 months on a Treasury note with 6 months remaining until maturity. What price would you expect a 6-month maturity Treasury bill to sell for?
9. Find the after-tax return to a corporation that buys a share of preferred stock at \$40, sells it at year-end at \$40, and receives a \$4 year-end dividend. The firm is in the 30% tax bracket.
10. Turn to Figure 2.8 and look at the listing for General Dynamics.
 - a. How many shares could you buy for \$5,000?
 - b. What would be your annual dividend income from those shares?
 - c. What must be General Dynamics earnings per share?
 - d. What was the firm’s closing price on the day before the listing?
11. Consider the three stocks in the following table. P_t represents price at time t , and Q_t represents shares outstanding at time t . Stock C splits two for one in the last period.

	P_0	Q_0	P_1	Q_1	P_2	Q_2
A	90	100	95	100	95	100
B	50	200	45	200	45	200
C	100	200	110	200	55	400

- a. Calculate the rate of return on a price-weighted index of the three stocks for the first period ($t = 0$ to $t = 1$).
 - b. What must happen to the divisor for the price-weighted index in year 2?
 - c. Calculate the rate of return for the second period ($t = 1$ to $t = 2$).
12. Using the data in the previous problem, calculate the first-period rates of return on the following indexes of the three stocks:
 - a. A market-value-weighted index.
 - b. An equally weighted index.
13. An investor is in a 30% tax bracket. If corporate bonds offer 9% yields, what must municipals offer for the investor to prefer them to corporate bonds?

PROBLEM SETS

i. Basic



ii. Intermediate

14. Find the equivalent taxable yield of a short-term municipal bond currently offering yields of 4% for tax brackets of zero, 10%, 20%, and 30%.
15. What problems would confront a mutual fund trying to create an index fund tied to an equally weighted index of a broad stock market?
16. Which security should sell at a greater price?
 - a. A 10-year Treasury bond with a 9% coupon rate versus a 10-year T-bond with a 10% coupon.
 - b. A 3-month expiration call option with an exercise price of \$40 versus a 3-month call on the same stock with an exercise price of \$35.
 - c. A put option on a stock selling at \$50, or a put option on another stock selling at \$60 (all other relevant features of the stocks and options may be assumed to be identical).
17. Look at the futures listings for the corn contract in Figure 2.10.
 - a. Suppose you buy one contract for March delivery. If the contract closes in March at a level of 3.875, what will your profit be?
 - b. How many March maturity contracts are outstanding?
18. Turn back to Figure 2.9 and look at the Intel options. Suppose you buy a November expiration call option with exercise price \$21.
 - a. Suppose the stock price in November is \$21.75 Will you exercise your call? What is the profit on your position?
 - b. What if you had bought the November call with exercise price \$22?
 - c. What if you had bought a November put with exercise price \$22?
19. Why do call options with exercise prices greater than the price of the underlying stock sell for positive prices?
20. Both a call and a put currently are traded on stock XYZ; both have strike prices of \$50 and expirations of 6 months. What will be the profit to an investor who buys the call for \$4 in the following scenarios for stock prices in 6 months? What will be the profit in each scenario to an investor who buys the put for \$6?
 - a. \$40
 - b. \$45
 - c. \$50
 - d. \$55
 - e. \$60

iii. Challenge

21. Explain the difference between a put option and a short position in a futures contract.
22. Explain the difference between a call option and a long position in a futures contract.



1. A firm's preferred stock often sells at yields below its bonds because
 - a. Preferred stock generally carries a higher agency rating.
 - b. Owners of preferred stock have a prior claim on the firm's earnings.
 - c. Owners of preferred stock have a prior claim on a firm's assets in the event of liquidation.
 - d. Corporations owning stock may exclude from income taxes most of the dividend income they receive.
2. A municipal bond carries a coupon of 6¾% and is trading at par. What is the equivalent taxable yield to a taxpayer in a combined federal plus state 34% tax bracket?
3. Which is the *most risky* transaction to undertake in the stock index option markets if the stock market is expected to increase substantially after the transaction is completed?
 - a. Write a call option.
 - b. Write a put option.
 - c. Buy a call option.
 - d. Buy a put option.

4. Short-term municipal bonds currently offer yields of 4%, while comparable taxable bonds pay 5%. Which gives you the higher after-tax yield if your tax bracket is:
 - a. Zero
 - b. 10%
 - c. 20%
 - d. 30%
5. The coupon rate on a tax-exempt bond is 5.6%, and the rate on a taxable bond is 8%. Both bonds sell at par. At what tax bracket (marginal tax rate) would an investor be indifferent between the two bonds?

Inflation-Protected Bonds around the World

Barclays maintains a Web site at www.barcap.com/inflation/index.shtml with information about inflation around the world and tools to help issuers and investors understand the inflation-linked asset class. Inflation-linked bonds were issued by a number of countries after 1945, including Israel, Argentina, Brazil, and Iceland. However, the modern market is generally deemed to have been born in 1981, when the first index-linked gilts were issued in the U.K. The other large markets adopted somewhat different calculations to those used by the U.K., mostly copying the more straightforward model first employed by Canada in 1991. In chronological order, the markets are the U.K. (1981), Australia (1985), Canada (1991), Sweden (1994), the United States (1997), France (1998), Italy (2003), and Japan (2004).

E-INVESTMENTS EXERCISES

SOLUTIONS TO CONCEPT CHECKS

1. The bond sells for 98:26 bid which is a price of 98.813% of par, or \$988.13, and 98:29 ask, or \$989.06. This ask price corresponds to a yield of 4.3156%. The ask price fell $\frac{20}{32}$ from its level yesterday, so the ask price then must have been 99:17, or \$995.31.
2. A 6% taxable return is equivalent to an after-tax return of $6(1 - .30) = 4.2\%$. Therefore, you would be better off in the taxable bond. The equivalent taxable yield of the tax-free bond is $4/(1 - .30) = 5.71\%$. So a taxable bond would have to pay a 5.71% yield to provide the same after-tax return as a tax-free bond offering a 4% yield.
3.
 - a. You are entitled to a prorated share of IBM's dividend payments and to vote in any of IBM's stockholder meetings.
 - b. Your potential gain is unlimited because IBM's stock price has no upper bound.
 - c. Your outlay was $\$80 \times 100 = \$8,000$. Because of limited liability, this is the most you can lose.
4. The price-weighted index increases from 62.5 [i.e., $(100 + 25)/2$] to 65 [i.e., $(110 + 20)/2$], a gain of 4%. An investment of one share in each company requires an outlay of \$125 that would increase in value to \$130, for a return of 4% (i.e., $5/125$), which equals the return to the price-weighted index.
5. The market-value-weighted index return is calculated by computing the increase in the value of the stock portfolio. The portfolio of the two stocks starts with an initial value of \$100 million + \$500 million = \$600 million and falls in value to \$110 million + \$400 million = \$510 million, a loss of $90/600 = .15$, or 15%. The index portfolio

return is a weighted average of the returns on each stock with weights of $\frac{1}{6}$ on XYZ and $\frac{5}{6}$ on ABC (weights proportional to relative investments). Because the return on XYZ is 10%, while that on ABC is -20% , the index portfolio return is $\frac{1}{6} \times 10\% + \frac{5}{6} \times (-20\%) = -15\%$, equal to the return on the market-value-weighted index.

6. The payoff to the call option is \$2 per share at expiration. The option cost is \$1.66 per share. The dollar profit is therefore \$.34. The put option expires worthless. Therefore, the investor's loss is the cost of the put, or \$.98.

5. Trading costs include explicit commissions as well as the bid–ask spread. An ongoing controversy among markets concerns overall trading costs including the effect of spreads and price impact. The NYSE argues that it is often the cheapest trading venue when quality of execution is recognized.
6. Buying on margin means borrowing money from a broker to buy more securities than can be purchased with one’s own money alone. By buying securities on a margin, an investor magnifies both the upside potential and the downside risk. If the equity in a margin account falls below the required maintenance level, the investor will get a margin call from the broker.
7. Short-selling is the practice of selling securities that the seller does not own. The short-seller borrows the securities sold through a broker and may be required to cover the short position at any time on demand. The cash proceeds of a short sale are kept in escrow by the broker, and the broker usually requires that the short-seller deposit additional cash or securities to serve as margin (collateral).
8. Securities trading is regulated by the Securities and Exchange Commission, by other government agencies, and through self-regulation of the exchanges. Many of the important regulations have to do with full disclosure of relevant information concerning the securities in question. Insider trading rules also prohibit traders from attempting to profit from inside information.

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primary market	bid price	specialist
secondary market	ask price	NASDAQ
initial public offerings (IPOs)	bid–ask spread	stock exchanges
underwriters	limit order	block transactions
prospectus	stop orders	program trade
private placement	over-the-counter (OTC) market	margin
dealer markets	electronic communication	short sale
auction market	networks (ECNs)	inside information

KEY TERMS

1. Call one full-service broker and one discount broker and find out the transaction costs of implementing the following strategies:
 - a. Buying 100 shares of IBM now and selling them 6 months from now.
 - b. Investing an equivalent amount in 6-month at-the-money call options on IBM stock now and selling them 6 months from now.
2. Who sets the bid and asked price for a stock traded over the counter? Would you expect the spread to be higher on actively or inactively traded stocks?
3. Suppose you short sell 100 shares of IBM, now selling at \$120 per share.
 - a. What is your maximum possible loss?
 - b. What happens to the maximum loss if you simultaneously place a stop-buy order at \$128?
4. A market order has:
 - a. Price uncertainty but not execution uncertainty.
 - b. Both price uncertainty and execution uncertainty.
 - c. Execution uncertainty but not price uncertainty.
5. Where would an illiquid security in a developing country *most likely* trade?
 - a. Broker markets.
 - b. Electronic crossing networks.
 - c. Electronic limit-order markets.
6. Déé Trader opens a brokerage account and purchases 300 shares of Internet Dreams at \$40 per share. She borrows \$4,000 from her broker to help pay for the purchase. The interest rate on the loan is 8%.
 - a. What is the margin in Déé’s account when she first purchases the stock?
 - b. If the share price falls to \$30 per share by the end of the year, what is the remaining margin in her account? If the maintenance margin requirement is 30%, will she receive a margin call?
 - c. What is the rate of return on her investment?

PROBLEM SETS

i. Basic



ii. Intermediate

7. Old Economy Traders opened an account to short sell 1,000 shares of Internet Dreams from the previous problem. The initial margin requirement was 50%. (The margin account pays no interest.) A year later, the price of Internet Dreams has risen from \$40 to \$50, and the stock has paid a dividend of \$2 per share.
- What is the remaining margin in the account?
 - If the maintenance margin requirement is 30%, will Old Economy receive a margin call?
 - What is the rate of return on the investment?
8. Consider the following limit-order book of a specialist. The last trade in the stock occurred at a price of \$50.

Limit Buy Orders		Limit Sell Orders	
Price	Shares	Price	Shares
\$49.75	500	\$50.25	100
49.50	800	51.50	100
49.25	500	54.75	300
49.00	200	58.25	100
48.50	600		

- If a market buy order for 100 shares comes in, at what price will it be filled?
 - At what price would the next market buy order be filled?
 - If you were the specialist, would you want to increase or decrease your inventory of this stock?
9. You are bullish on Telecom stock. The current market price is \$50 per share, and you have \$5,000 of your own to invest. You borrow an additional \$5,000 from your broker at an interest rate of 8% per year and invest \$10,000 in the stock.
- What will be your rate of return if the price of Telecom stock goes up by 10% during the next year? The stock currently pays no dividends.
 - How far does the price of Telecom stock have to fall for you to get a margin call if the maintenance margin is 30%? Assume the price fall happens immediately.
10. You are bearish on Telecom and decide to sell short 100 shares at the current market price of \$50 per share.
- How much in cash or securities must you put into your brokerage account if the broker's initial margin requirement is 50% of the value of the short position?
 - How high can the price of the stock go before you get a margin call if the maintenance margin is 30% of the value of the short position?
11. Suppose that Intel currently is selling at \$40 per share. You buy 500 shares using \$15,000 of your own money, borrowing the remainder of the purchase price from your broker. The rate on the margin loan is 8%.
- What is the percentage increase in the net worth of your brokerage account if the price of Intel *immediately* changes to: (i) \$44; (ii) \$40; (iii) \$36? What is the relationship between your percentage return and the percentage change in the price of Intel?
 - If the maintenance margin is 25%, how low can Intel's price fall before you get a margin call?
 - How would your answer to (b) change if you had financed the initial purchase with only \$10,000 of your own money?
 - What is the rate of return on your margined position (assuming again that you invest \$15,000 of your own money) if Intel is selling *after 1 year* at: (i) \$44; (ii) \$40; (iii) \$36? What is the relationship between your percentage return and the percentage change in the price of Intel? Assume that Intel pays no dividends.
 - Continue to assume that a year has passed. How low can Intel's price fall before you get a margin call?

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12. Suppose that you sell short 500 shares of Intel, currently selling for \$40 per share, and give your broker \$15,000 to establish your margin account.
- If you earn no interest on the funds in your margin account, what will be your rate of return after 1 year if Intel stock is selling at: (i) \$44; (ii) \$40; (iii) \$36? Assume that Intel pays no dividends.
 - If the maintenance margin is 25%, how high can Intel's price rise before you get a margin call?
 - Redo parts (a) and (b), but now assume that Intel also has paid a year-end dividend of \$1 per share. The prices in part (a) should be interpreted as ex-dividend, that is, prices after the dividend has been paid.
13. Here is some price information on Marriott:

	<u>Bid</u>	<u>Asked</u>
Marriott	19.95	20.05

You have placed a stop-loss order to sell at \$20. What are you telling your broker? Given market prices, will your order be executed?

14. Here is some price information on Fincorp stock. Suppose that Fincorp trades in a dealer market.

	<u>Bid</u>	<u>Asked</u>
	55.25	55.50

- Suppose you have submitted an order to your broker to buy at market. At what price will your trade be executed?
 - Suppose you have submitted an order to sell at market. At what price will your trade be executed?
 - Suppose you have submitted a limit order to sell at \$55.62. What will happen?
 - Suppose you have submitted a limit order to buy at \$55.37. What will happen?
15. Now reconsider the previous problem assuming that Fincorp sells in an exchange market like the NYSE.
- Is there any chance for the market buy order considered in part (a) to be executed at a price below \$55.50, and the sell order in part (b) at a price above \$55.25?
 - Is there any chance of an immediate trade at \$55.37 for the limit-buy order in part (d)?
16. You've borrowed \$20,000 on margin to buy shares in Disney, which is now selling at \$40 per share. Your account starts at the initial margin requirement of 50%. The maintenance margin is 35%. Two days later, the stock price falls to \$35 per share.
- Will you receive a margin call?
 - How low can the price of Disney shares fall before you receive a margin call?
17. On January 1, you sold short one round lot (that is, 100 shares) of Lowe's stock at \$21 per share. On March 1, a dividend of \$2 per share was paid. On April 1, you covered the short sale by buying the stock at a price of \$15 per share. You paid 50 cents per share in commissions for each transaction. What is the value of your account on April 1?

1. FBN, Inc., has just sold 100,000 shares in an initial public offering. The underwriter's explicit fees were \$70,000. The offering price for the shares was \$50, but immediately upon issue, the share price jumped to \$53.
- What is your best guess as to the total cost to FBN of the equity issue?
 - Is the entire cost of the underwriting a source of profit to the underwriters?



2. If you place a stop-loss order to sell 100 shares of stock at \$55 when the current price is \$62, how much will you receive for each share if the price drops to \$50?
 - a. \$50.
 - b. \$55.
 - c. \$54.87.
 - d. Cannot tell from the information given.
3. Specialists on the New York Stock Exchange do all of the following *except*:
 - a. Act as dealers for their own accounts.
 - b. Execute limit orders.
 - c. Help provide liquidity to the marketplace.
 - d. Act as odd-lot dealers.

E-INVEST- MENTS EXERCISES

Stock Market Listing Standards

Each exchange sets different criteria that must be satisfied for a stock to be listed there. The NYSE refers to their requirements as "Listing Standards." NASDAQ refers to the requirements as "Listing Qualifications." Listing requirements for these markets can be found at www.nyse.com and www.nasdaq.com. Find the listing requirements for firms with securities traded on each exchange. The NYSE also provides "continued listing standards." What are those requirements? Using the security search engine on either the NYSE or NASDAQ, search for stocks that do not meet the continued listing standards of the NYSE. Which variables would lead to the stock being delisted from the NYSE? What do you think is the likelihood that this stock will continue to be listed on the NYSE?

SOLUTIONS TO CONCEPT CHECKS

1. Limited-time shelf registration was introduced because its cost savings outweighed the disadvantage of slightly less up-to-date disclosures. Allowing unlimited shelf registration would circumvent "blue sky" laws that ensure proper disclosure as the financial circumstances of the firm change over time.
2.
 - a. Used cars trade in dealer markets (used-car lots or auto dealerships) and in direct search markets when individuals advertise in local newspapers or on the Web.
 - b. Paintings trade in broker markets when clients commission brokers to buy or sell art for them, in dealer markets at art galleries, and in auction markets.
 - c. Rare coins trade mostly in dealer markets in coin shops, but they also trade in auctions and in direct search markets when individuals advertise they want to buy or sell coins.
3.
 - a. You should give your broker a market order. It will be executed immediately and is the cheapest type of order in terms of brokerage fees.
 - b. You should give your broker a limit-buy order, which will be executed only if the shares can be obtained at a price about 5% below the current price.
 - c. You should give your broker a stop-loss order, which will be executed if the share price starts falling. The limit or stop price should be close to the current price to avoid the possibility of large losses.
4. Solving

$$\frac{100P - \$4,000}{100P} = .4$$

yields $P = \$66.67$ per share.

5. The investor will purchase 150 shares, with a rate of return as follows:

Year-End Change in Price	Year-End Value of Shares	Repayment of Principal and Interest	Investor's Rate of Return
30%	\$19,500	\$5,450	40.5%
No change	15,000	5,450	-4.5
-30%	10,500	5,450	-49.5

6. *a.* Once Dot Bomb stock goes up to \$110, your balance sheet will be:

Assets		Liabilities and Owner's Equity	
Cash	\$100,000	Short position in Dot Bomb	\$110,000
T-bills	50,000	Equity	40,000

b. Solving

$$\frac{\$150,000 - 1,000P}{1,000P} = .4$$

yields $P = \$107.14$ per share.

funds are assessed management fees and incur other expenses, which reduce the investor’s rate of return. Funds also eliminate some of the individual’s control over the timing of capital gains realizations.

4. Mutual funds are often categorized by investment policy. Major policy groups include money market funds; equity funds, which are further grouped according to emphasis on income versus growth; fixed-income funds; balanced and income funds; asset allocation funds; index funds; and specialized sector funds.
5. Costs of investing in mutual funds include front-end loads, which are sales charges; back-end loads, which are redemption fees or, more formally, contingent-deferred sales charges; fund operating expenses; and 12b-1 charges, which are recurring fees used to pay for the expenses of marketing the fund to the public.
6. Income earned on mutual fund portfolios is not taxed at the level of the fund. Instead, as long as the fund meets certain requirements for pass-through status, the income is treated as being earned by the investors in the fund.
7. The average rate of return of the average equity mutual fund in the last 40 years has been below that of a passive index fund holding a portfolio to replicate a broad-based index like the S&P 500 or Wilshire 5000. Some of the reasons for this disappointing record are the costs incurred by actively managed funds, such as the expense of conducting the research to guide stock-picking activities, and trading costs due to higher portfolio turnover. The record on the consistency of fund performance is mixed. In some sample periods, the better-performing funds continue to perform well in the following periods; in other sample periods they do not.

Related Web sites for this chapter are available at www.mhhe.com/bkm

investment company
net asset value (NAV)
unit investment trust
open-end fund

closed-end fund
load
hedge fund
12b-1 fees

soft dollars
turnover
exchange-traded funds

KEY TERMS

1. Would you expect a typical open-end fixed-income mutual fund to have higher or lower operating expenses than a fixed-income unit investment trust? Why?
2. What are some comparative advantages of investing in the following:
 - a. Unit investment trusts.
 - b. Open-end mutual funds.
 - c. Individual stocks and bonds that you choose for yourself.
3. Open-end equity mutual funds find it necessary to keep a significant percentage of total investments, typically around 5% of the portfolio, in very liquid money market assets. Closed-end funds do not have to maintain such a position in “cash equivalent” securities. What difference between open-end and closed-end funds might account for their differing policies?
4. Balanced funds, life-cycle funds, and asset allocation funds all invest in both the stock and bond markets. What are the differences among these types of funds?
5. Why can closed-end funds sell at prices that differ from net asset value while open-end funds do not?
6. What are the advantages and disadvantages of exchange-traded funds versus mutual funds?
7. An open-end fund has a net asset value of \$10.70 per share. It is sold with a front-end load of 6%. What is the offering price?
8. If the offering price of an open-end fund is \$12.30 per share and the fund is sold with a front-end load of 5%, what is its net asset value?

PROBLEM SETS

i. Basic

ii. Intermediate

9. The composition of the Fingroup Fund portfolio is as follows:

Stock	Shares	Price
A	200,000	\$35
B	300,000	40
C	400,000	20
D	600,000	25

The fund has not borrowed any funds, but its accrued management fee with the portfolio manager currently totals \$30,000. There are 4 million shares outstanding. What is the net asset value of the fund?

10. Reconsider the Fingroup Fund in the previous problem. If during the year the portfolio manager sells all of the holdings of stock D and replaces it with 200,000 shares of stock E at \$50 per share and 200,000 shares of stock F at \$25 per share, what is the portfolio turnover rate?
11. The Closed Fund is a closed-end investment company with a portfolio currently worth \$200 million. It has liabilities of \$3 million and 5 million shares outstanding.
- What is the NAV of the fund?
 - If the fund sells for \$36 per share, what is its premium or discount as a percent of net asset value?
12. Corporate Fund started the year with a net asset value of \$12.50. By year-end, its NAV equaled \$12.10. The fund paid year-end distributions of income and capital gains of \$1.50. What was the (pretax) rate of return to an investor in the fund?
13. A closed-end fund starts the year with a net asset value of \$12.00. By year-end, NAV equals \$12.10. At the beginning of the year, the fund was selling at a 2% premium to NAV. By the end of the year, the fund is selling at a 7% discount to NAV. The fund paid year-end distributions of income and capital gains of \$1.50.
- What is the rate of return to an investor in the fund during the year?
 - What would have been the rate of return to an investor who held the same securities as the fund manager during the year?
14. *a.* Impressive Fund had excellent investment performance last year, with portfolio returns that placed it in the top 10% of all funds with the same investment policy. Do you expect it to be a top performer next year? Why or why not?
- b.* Suppose instead that the fund was among the poorest performers in its comparison group. Would you be more or less likely to believe its relative performance will persist into the following year? Why?
15. Consider a mutual fund with \$200 million in assets at the start of the year and with 10 million shares outstanding. The fund invests in a portfolio of stocks that provides dividend income at the end of the year of \$2 million. The stocks included in the fund's portfolio increase in price by 8%, but no securities are sold, and there are no capital gains distributions. The fund charges 12b-1 fees of 1%, which are deducted from portfolio assets at year-end. What is net asset value at the start and end of the year? What is the rate of return for an investor in the fund?
16. The New Fund had average daily assets of \$2.2 billion last year. The fund sold \$400 million worth of stock and purchased \$500 million during the year. What was its turnover ratio?
17. If New Fund's expense ratio (see the previous problem) was 1.1% and the management fee was .7%, what were the total fees paid to the fund's investment managers during the year? What were other administrative expenses?
18. You purchased 1,000 shares of the New Fund at a price of \$20 per share at the beginning of the year. You paid a front-end load of 4%. The securities in which the fund invests increase in value by 12% during the year. The fund's expense ratio is 1.2%. What is your rate of return on the fund if you sell your shares at the end of the year?

19. Loaded-Up Fund charges a 12b-1 fee of 1.0% and maintains an expense ratio of .75%. Economy Fund charges a front-end load of 2% but has no 12b-1 fee and an expense ratio of .25%. Assume the rate of return on both funds' portfolios (before any fees) is 6% per year. How much will an investment in each fund grow to after:
 - a. 1 year.
 - b. 3 years.
 - c. 10 years.
20. City Street Fund has a portfolio of \$450 million and liabilities of \$10 million.
 - a. If 44 million shares are outstanding, what is net asset value?
 - b. If a large investor redeems 1 million shares, what happens to the portfolio value, to shares outstanding, and to NAV?
21. The Investments Fund sells Class A shares with a front-end load of 6% and Class B shares with 12b-1 fees of .5% annually as well as back-end load fees that start at 5% and fall by 1% for each full year the investor holds the portfolio (until the fifth year). Assume the portfolio rate of return net of operating expenses is 10% annually. If you plan to sell the fund after 4 years, are Class A or Class B shares the better choice for you? What if you plan to sell after 15 years?
22. You are considering an investment in a mutual fund with a 4% load and expense ratio of .5%. You can invest instead in a bank CD paying 6% interest.
 - a. If you plan to invest for 2 years, what annual rate of return must the fund portfolio earn for you to be better off in the fund than in the CD? Assume annual compounding of returns.
 - b. How does your answer change if you plan to invest for 6 years? Why does your answer change?
 - c. Now suppose that instead of a front-end load the fund assesses a 12b-1 fee of .75% per year. What annual rate of return must the fund portfolio earn for you to be better off in the fund than in the CD? Does your answer in this case depend on your time horizon?
23. Suppose that every time a fund manager trades stock, transaction costs such as commissions and bid-asked spreads amount to .4% of the value of the trade. If the portfolio turnover rate is 50%, by how much is the total return of the portfolio reduced by trading costs?
24. You expect a tax-free municipal bond portfolio to provide a rate of return of 4%. Management fees of the fund are .6%. What fraction of portfolio income is given up to fees? If the management fees for an equity fund also are .6%, but you expect a portfolio return of 12%, what fraction of portfolio income is given up to fees? Why might management fees be a bigger factor in your investment decision for bond funds than for stock funds? Can your conclusion help explain why unmanaged unit investment trusts tend to focus on the fixed-income market?
25. Suppose you observe the investment performance of 350 portfolio managers for 5 years and rank them by investment returns during each year. After 5 years, you find that 11 of the funds have investment returns that place the fund in the top half of the sample in each and every year of your sample. Such consistency of performance indicates to you that these must be the funds whose managers are in fact skilled, and you invest your money in these funds. Is your conclusion warranted?

iii. Challenge

Choosing a Mutual Fund

Go to finance.yahoo.com. Click on Mutual Funds under the Investing tab. Look for the Mutual Fund Screener. Use the drop-down boxes to select the criteria for mutual funds that are of interest to you. How many funds are shown in your results? If there are no funds or only a few funds that meet your criteria, try loosening your standards. If there are too many funds, try stricter standards. You can click on any column heading in the results list to sort by that criterion.

**E-INVEST-
MENTS
EXERCISES**

SOLUTIONS TO CONCEPT CHECKS

- NAV = $\frac{\$3,035.74 - \$83.08}{281.69} = \$10.48$
- The net investment in the Class A shares after the 4% commission is \$9,600. If the fund earns a 10% return, the investment will grow after n years to $\$9,600 \times (1.10)^n$. The Class B shares have no front-end load. However, the net return to the investor after 12b-1 fees will be only 9.5%. In addition, there is a back-end load that reduces the sales proceeds by a percentage equal to $(5 - \text{years until sale})$ until the fifth year, when the back-end load expires.

	Class A Shares	Class B Shares
Horizon	$\$9,600 \times (1.10)^n$	$\$10,000 \times (1.095)^n \times (1 - \text{percentage exit fee})$
1 year	\$10,560	$\$10,000 \times (1.095) \times (1 - .04) = \$10,512$
4 years	\$14,055	$\$10,000 \times (1.095)^4 \times (1 - .01) = \$14,233$
10 years	\$24,900	$\$10,000 \times (1.095)^{10} = \$24,782$

For a very short horizon such as 1 year, the Class A shares are the better choice. The front-end and back-end loads are equal, but the Class A shares don't have to pay the 12b-1 fees. For moderate horizons such as 4 years, the Class B shares dominate because the front-end load of the Class A shares is more costly than the 12b-1 fees and the now-smaller exit fee. For long horizons of 10 years or more, Class A again dominates. In this case, the one-time front-end load is less expensive than the continuing 12b-1 fees.

- Turnover = \$160,000 in trades per \$1 million of portfolio value = 16%.
 - Realized capital gains are $\$10 \times 1,000 = \$10,000$ on FedEx and $\$2.50 \times 4,000 = \$10,000$ on Cisco. The tax owed on the capital gains is therefore $.20 \times \$20,000 = \$4,000$.
- Twenty percent of the managers are skilled, which accounts for $.2 \times 400 = 80$ of those managers who appear in the top half. There are 120 slots left in the top half, and 320 other managers, so the probability of an unskilled manager "lucking into" the top half in any year is $120/320$, or .375. Therefore, of the 120 lucky managers in the first year, we would expect $.375 \times 120 = 45$ to repeat as top-half performers next year. Thus, we should expect a total of $80 + 45 = 125$, or 62.5%, of the better initial performers to repeat their top-half performance.

nominal interest rate
 real interest rate
 effective annual rate (EAR)
 annual percentage rate (APR)
 dividend yield
 risk-free rate
 risk premium

excess return
 risk aversion
 normal distribution
 event tree
 skew
 kurtosis
 value at risk (VaR)

expected shortfall (ES)
 conditional tail expectation
 (CTE)
 lower partial standard
 deviation (LPSD)
 Sortino ratio
 lognormal distribution

KEY TERMS

- The Fisher equation tells us that the real interest rate approximately equals the nominal rate minus the inflation rate. Suppose the inflation rate increases from 3% to 5%. Does the Fisher equation imply that this increase will result in a fall in the real rate of interest? Explain.
- You've just stumbled on a new dataset that enables you to compute historical rates of return on U.S. stocks all the way back to 1880. What are the advantages and disadvantages in using these data to help estimate the expected rate of return on U.S. stocks over the coming year?
- You are considering two alternative 2-year investments: You can invest in a risky asset with a positive risk premium and returns in each of the 2 years that will be identically distributed and uncorrelated, or you can invest in the risky asset for only 1 year and then invest the proceeds in a risk-free asset. Which of the following statements about the first investment alternative (compared with the second) are true?
 - Its 2-year risk premium is the same as the second alternative.
 - The standard deviation of its 2-year return is the same.
 - Its annualized standard deviation is lower.
 - Its Sharpe ratio is higher.
 - It is relatively more attractive to investors who have lower degrees of risk aversion.
- You have \$5,000 to invest for the next year and are considering three alternatives:
 - A money market fund with an average maturity of 30 days offering a current yield of 6% per year.
 - A 1-year savings deposit at a bank offering an interest rate of 7.5%.
 - A 20-year U.S. Treasury bond offering a yield to maturity of 9% per year.

What role does your forecast of future interest rates play in your decisions?
- Use Figure 5.1 in the text to analyze the effect of the following on the level of real interest rates:
 - Businesses become more pessimistic about future demand for their products and decide to reduce their capital spending.
 - Households are induced to save more because of increased uncertainty about their future Social Security benefits.
 - The Federal Reserve Board undertakes open-market purchases of U.S. Treasury securities in order to increase the supply of money.
- You are considering the choice between investing \$50,000 in a conventional 1-year bank CD offering an interest rate of 5% and a 1-year "Inflation-Plus" CD offering 1.5% per year plus the rate of inflation.
 - Which is the safer investment?
 - Which offers the higher expected return?
 - If you expect the rate of inflation to be 3% over the next year, which is the better investment? Why?
 - If we observe a risk-free nominal interest rate of 5% per year and a risk-free real rate of 1.5% on inflation-indexed bonds, can we infer that the market's expected rate of inflation is 3.5% per year?

PROBLEM SETS

i. Basic

ii. Intermediate

7. Suppose your expectations regarding the stock price are as follows:

State of the Market	Probability	Ending Price	HPR (including dividends)
Boom	.35	\$140	44.5%
Normal growth	.30	110	14.0
Recession	.35	80	-16.5

Use Equations 5.11 and 5.12 to compute the mean and standard deviation of the HPR on stocks.

8. Derive the probability distribution of the 1-year HPR on a 30-year U.S. Treasury bond with an 8% coupon if it is currently selling at par and the probability distribution of its yield to maturity a year from now is as follows:

State of the Economy	Probability	YTM
Boom	.20	11.0%
Normal growth	.50	8.0
Recession	.30	7.0

For simplicity, assume the entire 8% coupon is paid at the end of the year rather than every 6 months.

9. What is the standard deviation of a random variable q with the following probability distribution:

Value of q	Probability
0	.25
1	.25
2	.50

10. The continuously compounded annual return on a stock is normally distributed with a mean of 20% and standard deviation of 30%. With 95.44% confidence, we should expect its actual return in any particular year to be between which pair of values? *Hint:* Look again at Figure 5.4.
- 40.0% and 80.0%
 - 30.0% and 80.0%
 - 20.6% and 60.6%
 - 10.4% and 50.4%
11. Using historical risk premiums over the 1926–2009 period as your guide, what would be your estimate of the expected annual HPR on the S&P 500 stock portfolio if the current risk-free interest rate is 3%?
12. You can find annual holding-period returns for several asset classes at our Web site (www.mhhe.com/bkm); look for links to Chapter 5. Compute the means, standard deviations, skewness, and kurtosis of the annual HPR of large stocks and long-term Treasury bonds using only the 30 years of data between 1980 and 2009. How do these statistics compare with those computed from the data for the period 1926–1941? Which do you think are the most relevant statistics to use for projecting into the future?
13. During a period of severe inflation, a bond offered a nominal HPR of 80% per year. The inflation rate was 70% per year.
- What was the real HPR on the bond over the year?
 - Compare this real HPR to the approximation $r \approx R - i$.
14. Suppose that the inflation rate is expected to be 3% in the near future. Using the historical data provided in this chapter, what would be your predictions for:
- The T-bill rate?
 - The expected rate of return on large stocks?
 - The risk premium on the stock market?

15. An economy is making a rapid recovery from steep recession, and businesses foresee a need for large amounts of capital investment. Why would this development affect real interest rates?

Challenge Problems 16 and 17 are more difficult. You may need to review the definitions of call and put options in Chapter 2.

16. You are faced with the probability distribution of the HPR on the stock market index fund given in Spreadsheet 5.1 of the text. Suppose the price of a put option on a share of the index fund with exercise price of \$110 and time to expiration of 1 year is \$12.
- What is the probability distribution of the HPR on the put option?
 - What is the probability distribution of the HPR on a portfolio consisting of one share of the index fund and a put option?
 - In what sense does buying the put option constitute a purchase of insurance in this case?
17. Take as given the conditions described in the previous problem, and suppose the risk-free interest rate is 6% per year. You are contemplating investing \$107.55 in a 1-year CD and simultaneously buying a call option on the stock market index fund with an exercise price of \$110 and expiration of 1 year. What is the probability distribution of your dollar return at the end of the year?

iii. Challenge

1. Given \$100,000 to invest, what is the expected risk premium in dollars of investing in equities versus risk-free T-bills (U.S. Treasury bills) based on the following table?



Action	Probability	Expected Return
Invest in equities	.6	\$50,000
	.4	-\$30,000
Invest in risk-free T-bill	1.0	\$ 5,000

2. Based on the scenarios below, what is the expected return for a portfolio with the following return profile?

	Market Condition		
	Bear	Normal	Bull
Probability	.2	.3	.5
Rate of return	-25%	10%	24%

Use the following scenario analysis for Stocks X and Y to answer CFA Problems 3 through 6 (round to the nearest percent).

	Bear Market	Normal Market	Bull Market
Probability	0.2	0.5	0.3
Stock X	-20%	18%	50%
Stock Y	-15%	20%	10%

- What are the expected rates of return for Stocks X and Y?
- What are the standard deviations of returns on Stocks X and Y?
- Assume that of your \$10,000 portfolio, you invest \$9,000 in Stock X and \$1,000 in Stock Y. What is the expected return on your portfolio?

6. Probabilities for three states of the economy and probabilities for the returns on a particular stock in each state are shown in the table below.

State of Economy	Probability of Economic State	Stock Performance	Probability of Stock Performance in Given Economic State
Good	.3	Good	.6
		Neutral	.3
		Poor	.1
Neutral	.5	Good	.4
		Neutral	.3
		Poor	.3
Poor	.2	Good	.2
		Neutral	.3
		Poor	.5

What is the probability that the economy will be neutral *and* the stock will experience poor performance?

7. An analyst estimates that a stock has the following probabilities of return depending on the state of the economy:

State of Economy	Probability	Return
Good	.1	15%
Normal	.6	13
Poor	.3	7

What is the expected return of the stock?

E-INVESTMENTS EXERCISES

Inflation and Rates

The Federal Reserve Bank of St. Louis has information available on interest rates and economic conditions. A publication called *Monetary Trends* contains graphs and tables with information about current conditions in the capital markets. Go to the Web site www.stls.frb.org and click on *Economic Research* on the menu at the top of the page. Find the most recent issue of *Monetary Trends* in the *Recent Data Publications* section and answer these questions.

1. What is the professionals' consensus forecast for inflation for the next 2 years? (Use the *Federal Reserve Bank of Philadelphia* line on the graph to answer this.)
2. What do consumers expect to happen to inflation over the next 2 years? (Use the *University of Michigan* line on the graph to answer this.)
3. Have real interest rates increased, decreased, or remained the same over the last 2 years?
4. What has happened to short-term nominal interest rates over the last 2 years? What about long-term nominal interest rates?
5. How do recent U.S. inflation and long-term interest rates compare with those of the other countries listed?
6. What are the most recently available levels of 3-month and 10-year yields on Treasury securities?

SOLUTIONS TO CONCEPT CHECKS

- $1 + R = (1 + r)(1 + i) = (1.03)(1.08) = 1.1124$
 $R = 11.24\%$
 - $1 + R = (1.03)(1.10) = 1.133$
 $R = 13.3\%$
- $\text{EAR} = (1 + .01)^{12} - 1 = .1268 = 12.68\%$
 - $\text{EAR} = e^{.12} - 1 = .1275 = 12.75\%$

Choose the continuously compounded rate for its higher EAR.
- Number of bonds bought is $27,000/900 = 30$

Interest Rates	Probability	Year-end Bond Price	HPR	End-of-Year Value
High	.2	\$850	$(75 + 850)/900 - 1 = .0278$	$(75 + 850)30 = \$27,750$
Unchanged	.5	915	.1000	\$29,700
Low	.3	985	.1778	\$31,800
Expected rate of return			.1089	
Expected end-of-year dollar value				\$29,940
Risk premium			.0589	

- $(1 + \text{Required rate})(1 - .386) = 1$
Required rate = .6287, or 62.87%
- Arithmetic return = $(1/3)(.2869) + (1/3)(.1088) + (1/3)(0.0491) = .1483 = 14.83\%$
 - Geometric average = $\sqrt[3]{1.2869 \times 1.1088 \times 1.0491} - 1 = .1439 = 14.39\%$
 - Standard deviation = 12.37%
 - Sharpe ratio = $(14.83 - 6.0)/12.37 = .71$
- The probability of a more extreme bad month, with return below -15% , is much lower: $\text{NORMDIST}(-15, 1.6, \text{TRUE}) = .00383$. Alternatively, we can note that -15% is $16/6$ standard deviations below the mean return, and use the standard normal function to compute $\text{NORMSDIST}(-16/6) = .00383$.
- If the probabilities in Spreadsheet 5.2 represented the true return distribution, we would use Equations 5.19 and 5.20 to obtain: Skew = 0.0931; Kurtosis = -1.2081 . However, in this case, the data in the table represent a (short) historical sample, and correction for degrees-of-freedom bias is required (in a similar manner to our calculations for standard deviation). You can use Excel functions to obtain: $\text{SKEW}(C5:C9) = 0.1387$; $\text{KURT}(C5:C9) = -0.2832$.

8. The investor’s degree of risk aversion is characterized by the slope of his or her indifference curve. Indifference curves show, at any level of expected return and risk, the required risk premium for taking on one additional percentage point of standard deviation. More risk-averse investors have steeper indifference curves; that is, they require a greater risk premium for taking on more risk.
9. The optimal position, y^* , in the risky asset, is proportional to the risk premium and inversely proportional to the variance and degree of risk aversion:

$$y^* = \frac{E(r_p) - r_f}{A\sigma_p^2}$$

Graphically, this portfolio represents the point at which the indifference curve is tangent to the CAL.

10. A passive investment strategy disregards security analysis, targeting instead the risk-free asset and a broad portfolio of risky assets such as the S&P 500 stock portfolio. If in 2009 investors took the mean historical return and standard deviation of the S&P 500 as proxies for its expected return and standard deviation, then the values of outstanding assets would imply a degree of risk aversion of about $A = 2.15$ for the average investor. This is in line with other studies, which estimate typical risk aversion in the range of 2.0 through 4.0.

Related Web sites for this chapter are available at www.mhhe.com/bkm

risk premium
fair game
risk averse
utility
certainty equivalent rate

risk neutral
risk lover
mean-variance (M-V) criterion
indifference curve
complete portfolio

risk-free asset
capital allocation line
reward-to-volatility ratio
passive strategy
capital market line

KEY TERMS

1. Which of the following choices best completes the following statement? Explain. An investor with a higher degree of risk aversion, compared to one with a lower degree, will prefer investment portfolios
 - a. with higher risk premiums.
 - b. that are riskier (with higher standard deviations).
 - c. with lower Sharpe ratios.
 - d. with higher Sharpe ratios.
 - e. None of the above is true.
2. Which of the following statements are true? Explain.
 - a. A lower allocation to the risky portfolio reduces the Sharpe (reward-to-volatility) ratio.
 - b. The higher the borrowing rate, the lower the Sharpe ratios of levered portfolios.
 - c. With a fixed risk-free rate, doubling the expected return and standard deviation of the risky portfolio will double the Sharpe ratio.
 - d. Holding constant the risk premium of the risky portfolio, a higher risk-free rate will increase the Sharpe ratio of investments with a positive allocation to the risky asset.
3. What do you think would happen to the expected return on stocks if investors perceived higher volatility in the equity market? Relate your answer to Equation 6.7.
4. Consider a risky portfolio. The end-of-year cash flow derived from the portfolio will be either \$70,000 or \$200,000 with equal probabilities of .5. The alternative risk-free investment in T-bills pays 6% per year.
 - a. If you require a risk premium of 8%, how much will you be willing to pay for the portfolio?
 - b. Suppose that the portfolio can be purchased for the amount you found in (a). What will be the expected rate of return on the portfolio?

PROBLEM SETS

i. Basic

ii. Intermediate

- c. Now suppose that you require a risk premium of 12%. What is the price that you will be willing to pay?
 - d. Comparing your answers to (a) and (c), what do you conclude about the relationship between the required risk premium on a portfolio and the price at which the portfolio will sell?
5. Consider a portfolio that offers an expected rate of return of 12% and a standard deviation of 18%. T-bills offer a risk-free 7% rate of return. What is the maximum level of risk aversion for which the risky portfolio is still preferred to bills?
 6. Draw the indifference curve in the expected return–standard deviation plane corresponding to a utility level of .05 for an investor with a risk aversion coefficient of 3. (*Hint:* Choose several possible standard deviations, ranging from 0 to .25, and find the expected rates of return providing a utility level of .05. Then plot the expected return–standard deviation points so derived.)
 7. Now draw the indifference curve corresponding to a utility level of .05 for an investor with risk aversion coefficient $A = 4$. Comparing your answer to Problem 6, what do you conclude?
 8. Draw an indifference curve for a risk-neutral investor providing utility level .05.
 9. What must be true about the sign of the risk aversion coefficient, A , for a risk lover? Draw the indifference curve for a utility level of .05 for a risk lover.

For Problems 10 through 12: Consider historical data showing that the average annual rate of return on the S&P 500 portfolio over the past 80 years has averaged roughly 8% more than the Treasury bill return and that the S&P 500 standard deviation has been about 20% per year. Assume these values are representative of investors' expectations for future performance and that the current T-bill rate is 5%.

10. Calculate the expected return and variance of portfolios invested in T-bills and the S&P 500 index with weights as follows:

W_{bills}	W_{index}
0	1.0
0.2	0.8
0.4	0.6
0.6	0.4
0.8	0.2
1.0	0

11. Calculate the utility levels of each portfolio of Problem 10 for an investor with $A = 2$. What do you conclude?
12. Repeat Problem 11 for an investor with $A = 3$. What do you conclude?

Use these inputs for Problems 13 through 19: You manage a risky portfolio with expected rate of return of 18% and standard deviation of 28%. The T-bill rate is 8%.

13. Your client chooses to invest 70% of a portfolio in your fund and 30% in a T-bill money market fund. What is the expected value and standard deviation of the rate of return on his portfolio?
14. Suppose that your risky portfolio includes the following investments in the given proportions:

Stock A	25%
Stock B	32%
Stock C	43%

What are the investment proportions of your client's overall portfolio, including the position in T-bills?

15. What is the reward-to-volatility ratio (S) of your risky portfolio? Your client's?

16. Draw the CAL of your portfolio on an expected return–standard deviation diagram. What is the slope of the CAL? Show the position of your client on your fund’s CAL.
17. Suppose that your client decides to invest in your portfolio a proportion y of the total investment budget so that the overall portfolio will have an expected rate of return of 16%.
 - a. What is the proportion y ?
 - b. What are your client’s investment proportions in your three stocks and the T-bill fund?
 - c. What is the standard deviation of the rate of return on your client’s portfolio?
18. Suppose that your client prefers to invest in your fund a proportion y that maximizes the expected return on the complete portfolio subject to the constraint that the complete portfolio’s standard deviation will not exceed 18%.
 - a. What is the investment proportion, y ?
 - b. What is the expected rate of return on the complete portfolio?
19. Your client’s degree of risk aversion is $A = 3.5$.
 - a. What proportion, y , of the total investment should be invested in your fund?
 - b. What is the expected value and standard deviation of the rate of return on your client’s optimized portfolio?
20. Look at the data in Table 6.7 on the average risk premium of the S&P 500 over T-bills, and the standard deviation of that risk premium. Suppose that the S&P 500 is your risky portfolio.
 - a. If your risk-aversion coefficient is $A = 4$ and you believe that the entire 1926–2009 period is representative of future expected performance, what fraction of your portfolio should be allocated to T-bills and what fraction to equity?
 - b. What if you believe that the 1968–1988 period is representative?
 - c. What do you conclude upon comparing your answers to (a) and (b)?
21. Consider the following information about a risky portfolio that you manage, and a risk-free asset: $E(r_P) = 11\%$, $\sigma_P = 15\%$, $r_f = 5\%$.
 - a. Your client wants to invest a proportion of her total investment budget in your risky fund to provide an expected rate of return on her overall or complete portfolio equal to 8%. What proportion should she invest in the risky portfolio, P , and what proportion in the risk-free asset?
 - b. What will be the standard deviation of the rate of return on her portfolio?
 - c. Another client wants the highest return possible subject to the constraint that you limit his standard deviation to be no more than 12%. Which client is more risk averse?
22. Investment Management Inc. (IMI) uses the capital market line to make asset allocation recommendations. IMI derives the following forecasts:
 - Expected return on the market portfolio: 12%.
 - Standard deviation on the market portfolio: 20%.
 - Risk-free rate: 5%.

Samuel Johnson seeks IMI’s advice for a portfolio asset allocation. Johnson informs IMI that he wants the standard deviation of the portfolio to equal half of the standard deviation for the market portfolio. Using the capital market line, what expected return can IMI provide subject to Johnson’s risk constraint?

For Problems 23 through 26: Suppose that the borrowing rate that your client faces is 9%. Assume that the S&P 500 index has an expected return of 13% and standard deviation of 25%, that $r_f = 5\%$, and that your fund has the parameters given in Problem 21.

23. Draw a diagram of your client’s CML, accounting for the higher borrowing rate. Superimpose on it two sets of indifference curves, one for a client who will choose to borrow, and one who will invest in both the index fund and a money market fund.

24. What is the range of risk aversion for which a client will neither borrow nor lend, that is, for which $y = 1$?
25. Solve Problems 23 and 24 for a client who uses your fund rather than an index fund.
26. What is the largest percentage fee that a client who currently is lending ($y < 1$) will be willing to pay to invest in your fund? What about a client who is borrowing ($y > 1$)?

iii. Challenge

For Challenge Problems 27 and 28: You estimate that a passive portfolio, that is, one invested in a risky portfolio that mimics the S&P 500 stock index, yields an expected rate of return of 13% with a standard deviation of 25%. You manage an active portfolio with expected return 18% and standard deviation 28%. The risk-free rate is 8%.

27. Draw the CML and your funds' CAL on an expected return–standard deviation diagram.
 - a. What is the slope of the CML?
 - b. Characterize in one short paragraph the advantage of your fund over the passive fund.
28. Your client ponders whether to switch the 70% that is invested in your fund to the passive portfolio.
 - a. Explain to your client the disadvantage of the switch.
 - b. Show him the maximum fee you could charge (as a percentage of the investment in your fund, deducted at the end of the year) that would leave him at least as well off investing in your fund as in the passive one. (*Hint:* The fee will lower the slope of his CAL by reducing the expected return net of the fee.)
29. Consider again the client in Problem 19 with $A = 3.5$.
 - a. If he chose to invest in the passive portfolio, what proportion, y , would he select?
 - b. Is the fee (percentage of the investment in your fund, deducted at the end of the year) that you can charge to make the client indifferent between your fund and the passive strategy affected by his capital allocation decision (i.e., his choice of y)?

Use the following data in answering CFA Problems 1–3:



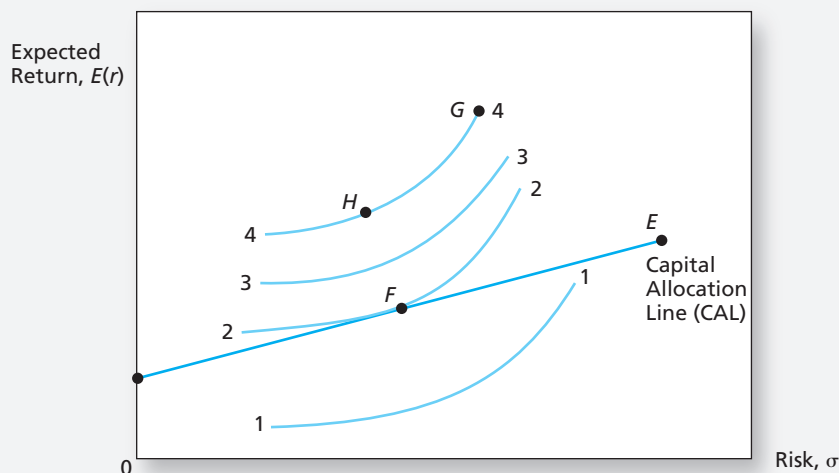
Utility Formula Data

Investment	Expected Return, $E(r)$	Standard Deviation, σ
1	.12	.30
2	.15	.50
3	.21	.16
4	.24	.21

$$U = E(r) - \frac{1}{2} A \sigma^2, \text{ where } A = 4$$

1. On the basis of the utility formula above, which investment would you select if you were risk averse with $A = 4$?
2. On the basis of the utility formula above, which investment would you select if you were risk neutral?
3. The variable (A) in the utility formula represents the:
 - a. investor's return requirement.
 - b. investor's aversion to risk.
 - c. certainty equivalent rate of the portfolio.
 - d. preference for one unit of return per four units of risk.

Use the following graph to answer CFA Problems 4 and 5.



4. Which indifference curve represents the greatest level of utility that can be achieved by the investor?
5. Which point designates the optimal portfolio of risky assets?
6. Given \$100,000 to invest, what is the expected risk premium in dollars of investing in equities versus risk-free T-bills on the basis of the following table?

Action	Probability	Expected Return
Invest in equities	.6	\$50,000
	.4	-\$30,000
Invest in risk-free T-bills	1.0	\$ 5,000

7. The change from a straight to a kinked capital allocation line is a result of the:
 - a. Reward-to-volatility ratio increasing.
 - b. Borrowing rate exceeding the lending rate.
 - c. Investor's risk tolerance decreasing.
 - d. Increase in the portfolio proportion of the risk-free asset.
8. You manage an equity fund with an expected risk premium of 10% and an expected standard deviation of 14%. The rate on Treasury bills is 6%. Your client chooses to invest \$60,000 of her portfolio in your equity fund and \$40,000 in a T-bill money market fund. What is the expected return and standard deviation of return on your client's portfolio?
9. What is the reward-to-volatility ratio for the *equity fund* in CFA Problem 8?

Risk Aversion

There is a difference between an investor's *willingness* to take risk and his or her *ability* to take risk. Take the quizzes offered at the Web sites below and compare the results. If they are significantly different, which one would you use to determine an investment strategy?

<http://mutualfunds.about.com/library/personalitytests/blrisktolerance.htm>

<http://mutualfunds.about.com/library/personalitytests/blriskcapacity.htm>

E-INVESTMENTS EXERCISES

SOLUTIONS TO CONCEPT CHECKS

- The investor is taking on exchange rate risk by investing in a pound-denominated asset. If the exchange rate moves in the investor's favor, the investor will benefit and will earn more from the U.K. bill than the U.S. bill. For example, if both the U.S. and U.K. interest rates are 5%, and the current exchange rate is \$2 per pound, a \$2 investment today can buy 1 pound, which can be invested in England at a certain rate of 5%, for a year-end value of 1.05 pounds. If the year-end exchange rate is \$2.10 per pound, the 1.05 pounds can be exchanged for $1.05 \times \$2.10 = \2.205 for a rate of return in dollars of $1 + r = \$2.205/\$2 = 1.1025$, or $r = 10.25\%$, more than is available from U.S. bills. Therefore, if the investor expects favorable exchange rate movements, the U.K. bill is a speculative investment. Otherwise, it is a gamble.
- For the $A = 4$ investor the utility of the risky portfolio is

$$U = .02 - (\frac{1}{2} \times 4 \times .3^2) = .02$$

while the utility of bills is

$$U = .07 - (\frac{1}{2} \times 4 \times 0) = .07$$

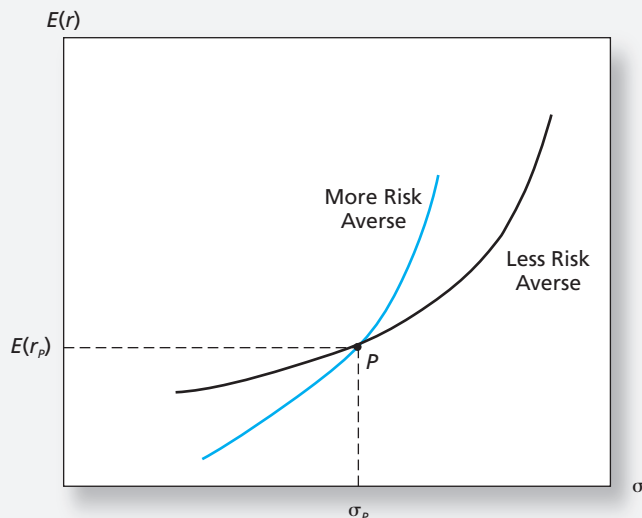
The investor will prefer bills to the risky portfolio. (Of course, a mixture of bills and the portfolio might be even better, but that is not a choice here.)

Even for the $A = 2$ investor, the utility of the risky portfolio is

$$U = .20 - (\frac{1}{2} \times 2 \times .3^2) = .11$$

while the utility of bills is again .07. The less risk-averse investor prefers the risky portfolio.

- The less risk-averse investor has a shallower indifference curve. An increase in risk requires less increase in expected return to restore utility to the original level.



- Holding 50% of your invested capital in Ready Assets means that your investment proportion in the risky portfolio is reduced from 70% to 50%.

Your risky portfolio is constructed to invest 54% in E and 46% in B . Thus the proportion of E in your overall portfolio is $.5 \times 54\% = 27\%$, and the dollar value of your position in E is $\$300,000 \times .27 = \$81,000$.

5. In the expected return–standard deviation plane all portfolios that are constructed from the same risky and risk-free funds (with various proportions) lie on a line from the risk-free rate through the risky fund. The slope of the CAL (capital allocation line) is the same everywhere; hence the reward-to-volatility ratio is the same for all of these portfolios. Formally, if you invest a proportion, y , in a risky fund with expected return $E(r_p)$ and standard deviation σ_p , and the remainder, $1 - y$, in a risk-free asset with a sure rate r_f , then the portfolio's expected return and standard deviation are

$$\begin{aligned} E(r_C) &= r_f + y[E(r_p) - r_f] \\ \sigma_C &= y\sigma_p \end{aligned}$$

and therefore the reward-to-volatility ratio of this portfolio is

$$S_C = \frac{E(r_C) - r_f}{\sigma_C} = \frac{y[E(r_p) - r_f]}{y\sigma_p} = \frac{E(r_p) - r_f}{\sigma_p}$$

which is independent of the proportion y .

6. The lending and borrowing rates are unchanged at $r_f = 7\%$, $r_f^B = 9\%$. The standard deviation of the risky portfolio is still 22%, but its expected rate of return shifts from 15% to 17%.

The slope of the two-part CAL is

$$\begin{aligned} &\frac{E(r_p) - r_f}{\sigma_p} \text{ for the lending range} \\ &\frac{E(r_p) - r_f^B}{\sigma_p} \text{ for the borrowing range} \end{aligned}$$

Thus in both cases the slope increases: from 8/22 to 10/22 for the lending range, and from 6/22 to 8/22 for the borrowing range.

7. a. The parameters are $r_f = .07$, $E(r_p) = .15$, $\sigma_p = .22$. An investor with a degree of risk aversion A will choose a proportion y in the risky portfolio of

$$y = \frac{E(r_p) - r_f}{A\sigma_p^2}$$

With the assumed parameters and with $A = 3$ we find that

$$y = \frac{.15 - .07}{3 \times .0484} = .55$$

When the degree of risk aversion decreases from the original value of 4 to the new value of 3, investment in the risky portfolio increases from 41% to 55%. Accordingly, both the expected return and standard deviation of the optimal portfolio increase:

$$\begin{aligned} E(r_C) &= .07 + (.55 \times .08) = .114 \text{ (before: .1028)} \\ \sigma_C &= .55 \times .22 = .121 \text{ (before: .0902)} \end{aligned}$$

- b. All investors whose degree of risk aversion is such that they would hold the risky portfolio in a proportion equal to 100% or less ($y \leq 1.00$) are lending rather than borrowing, and so are unaffected by the borrowing rate. The least risk-averse of these investors hold 100% in the risky portfolio ($y = 1$). We can solve for the degree of risk aversion of these “cut off” investors from the parameters of the investment opportunities:

$$y = 1 = \frac{E(r_p) - r_f}{A\sigma_p^2} = \frac{.08}{.0484 A}$$

which implies

$$A = \frac{.08}{.0484} = 1.65$$

Any investor who is more risk tolerant (that is, $A < 1.65$) would borrow *if* the borrowing rate were 7%. For borrowers,

$$y = \frac{E(r_p) - r_f^B}{A\sigma_p^2}$$

Suppose, for example, an investor has an A of 1.1. When $r_f = r_f^B = 7\%$, this investor chooses to invest in the risky portfolio:

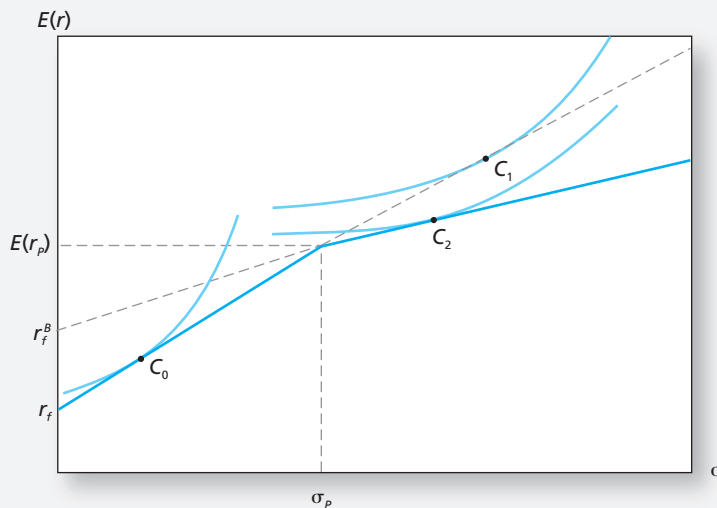
$$y = \frac{.08}{1.1 \times .0484} = 1.50$$

which means that the investor will borrow an amount equal to 50% of her own investment capital. Raise the borrowing rate, in this case to $r_f^B = 9\%$, and the investor will invest less in the risky asset. In that case:

$$y = \frac{.06}{1.1 \times .0484} = 1.13$$

and “only” 13% of her investment capital will be borrowed. Graphically, the line from r_f to the risky portfolio shows the CAL for lenders. The dashed part *would* be relevant if the borrowing rate equaled the lending rate. When the borrowing rate exceeds the lending rate, the CAL is kinked at the point corresponding to the risky portfolio.

The following figure shows indifference curves of two investors. The steeper indifference curve portrays the more risk-averse investor, who chooses portfolio C_0 , which involves lending. This investor’s choice is unaffected by the borrowing rate. The more risk-tolerant investor is portrayed by the shallower-sloped indifference curves. If the lending rate equaled the borrowing rate, this investor would choose portfolio C_1 on the dashed part of the CAL. When the borrowing rate goes up, this investor chooses portfolio C_2 (in the borrowing range of the kinked CAL), which involves less borrowing than before. This investor is hurt by the increase in the borrowing rate.



8. If all the investment parameters remain unchanged, the only reason for an investor to decrease the investment proportion in the risky asset is an increase in the degree of risk aversion. If you think that this is unlikely, then you have to reconsider your faith in your assumptions. Perhaps the S&P 500 is not a good proxy for the optimal risky portfolio. Perhaps investors expect a higher real rate on T-bills.

9. Diversification is based on the allocation of a *fixed* portfolio across several assets, limiting the exposure to any one source of risk. Adding additional risky assets to a portfolio, thereby increasing the total amounts invested, does not reduce dollar risk, even if it makes the rate of return more predictable. This is because that uncertainty is applied to a larger investment base. Nor does investing over longer horizons reduce risk. Increasing the investment horizon is analogous to investing in more assets. It increases total risk. Analogously, the key to the insurance industry is risk sharing—the spreading of risk across many investors, each of whom takes on only a small exposure to any given source of risk. Risk pooling—the assumption of ever-more sources of risk—may increase rate of return predictability, but not the predictability of total dollar returns.

Related Web sites for this chapter are available at www.mhhe.com/bkm

diversification
insurance principle
market risk
systematic risk
nondiversifiable risk
unique risk
firm-specific risk

nonsystematic risk
diversifiable risk
minimum-variance portfolio
portfolio opportunity set
reward-to-volatility ratio
optimal risky portfolio
minimum-variance frontier

efficient frontier of risky assets
input list
separation property
risk pooling
risk sharing

KEY TERMS

1. Which of the following factors reflect *pure* market risk for a given corporation?
 - a. Increased short-term interest rates.
 - b. Fire in the corporate warehouse.
 - c. Increased insurance costs.
 - d. Death of the CEO.
 - e. Increased labor costs.
2. When adding real estate to an asset allocation program that currently includes only stocks, bonds, and cash, which of the properties of real estate returns affect portfolio *risk*? Explain.
 - a. Standard deviation.
 - b. Expected return.
 - c. Correlation with returns of the other asset classes.
3. Which of the following statements about the minimum variance portfolio of all risky securities are valid? (Assume short sales are allowed.) Explain.
 - a. Its variance must be lower than those of all other securities or portfolios.
 - b. Its expected return can be lower than the risk-free rate.
 - c. It may be the optimal risky portfolio.
 - d. It must include all individual securities.

PROBLEM SETS

i. Basic

ii. Intermediate

The following data apply to Problems 4 through 10: A pension fund manager is considering three mutual funds. The first is a stock fund, the second is a long-term government and corporate bond fund, and the third is a T-bill money market fund that yields a rate of 8%. The probability distribution of the risky funds is as follows:

	Expected Return	Standard Deviation
Stock fund (<i>S</i>)	20%	30%
Bond fund (<i>B</i>)	12	15

The correlation between the fund returns is .10.

4. What are the investment proportions in the minimum-variance portfolio of the two risky funds, and what is the expected value and standard deviation of its rate of return?
5. Tabulate and draw the investment opportunity set of the two risky funds. Use investment proportions for the stock fund of zero to 100% in increments of 20%.

6. Draw a tangent from the risk-free rate to the opportunity set. What does your graph show for the expected return and standard deviation of the optimal portfolio?
7. Solve numerically for the proportions of each asset and for the expected return and standard deviation of the optimal risky portfolio.
8. What is the reward-to-volatility ratio of the best feasible CAL?
9. You require that your portfolio yield an expected return of 14%, and that it be efficient, on the best feasible CAL.
 - a. What is the standard deviation of your portfolio?
 - b. What is the proportion invested in the T-bill fund and each of the two risky funds?
10. If you were to use only the two risky funds, and still require an expected return of 14%, what would be the investment proportions of your portfolio? Compare its standard deviation to that of the optimized portfolio in Problem 9. What do you conclude?
11. Stocks offer an expected rate of return of 18%, with a standard deviation of 22%. Gold offers an expected return of 10% with a standard deviation of 30%.
 - a. In light of the apparent inferiority of gold with respect to both mean return and volatility, would anyone hold gold? If so, demonstrate graphically why one would do so.
 - b. Given the data above, reanswer (a) with the additional assumption that the correlation coefficient between gold and stocks equals 1. Draw a graph illustrating why one would or would not hold gold in one's portfolio. Could this set of assumptions for expected returns, standard deviations, and correlation represent an equilibrium for the security market?
12. Suppose that there are many stocks in the security market and that the characteristics of stocks *A* and *B* are given as follows:

Stock	Expected Return	Standard Deviation
A	10%	5%
B	15	10

Correlation = -1

Suppose that it is possible to borrow at the risk-free rate, r_f . What must be the value of the risk-free rate? (*Hint*: Think about constructing a risk-free portfolio from stocks *A* and *B*.)

13. Assume that expected returns and standard deviations for all securities (including the risk-free rate for borrowing and lending) are known. In this case all investors will have the same optimal risky portfolio. (True or false?)
14. The standard deviation of the portfolio is always equal to the weighted average of the standard deviations of the assets in the portfolio. (True or false?)
15. Suppose you have a project that has a .7 chance of doubling your investment in a year and a .3 chance of halving your investment in a year. What is the standard deviation of the rate of return on this investment?
16. Suppose that you have \$1 million and the following two opportunities from which to construct a portfolio:
 - a. Risk-free asset earning 12% per year.
 - b. Risky asset with expected return of 30% per year and standard deviation of 40%.
 If you construct a portfolio with a standard deviation of 30%, what is its expected rate of return?

The following data are for Problems 17 through 19: The correlation coefficients between pairs of stocks are as follows: $\text{Corr}(A,B) = .85$; $\text{Corr}(A,C) = .60$; $\text{Corr}(A,D) = .4$

5. Each stock has an expected return of 8% and a standard deviation of 20%.
17. If your entire portfolio is now composed of stock *A* and you can add some of only one stock to your portfolio, would you choose (explain your choice):
 - a. *B*.
 - b. *C*.
 - c. *D*.
 - d. Need more data.

18. Would the answer to Problem 17 change for more risk-averse or risk-tolerant investors? Explain.
19. Suppose that in addition to investing in one more stock you can invest in T-bills as well. Would you change your answers to Problems 17 and 18 if the T-bill rate is 8%?

The following table of compound annual returns by decade applies to Challenge Problems 20 and 21. iii. Challenge

	1920s*	1930s	1940s	1950s	1960s	1970s	1980s	1990s
Small-company stocks	-3.72%	7.28%	20.63%	19.01%	13.72%	8.75%	12.46%	13.84%
Large-company stocks	18.36	-1.25	9.11	19.41	7.84	5.90	17.60	18.20
Long-term government	3.98	4.60	3.59	0.25	1.14	6.63	11.50	8.60
Intermediate-term government	3.77	3.91	1.70	1.11	3.41	6.11	12.01	7.74
Treasury bills	3.56	0.30	0.37	1.87	3.89	6.29	9.00	5.02
Inflation	-1.00	-2.04	5.36	2.22	2.52	7.36	5.10	2.93

*Based on the period 1926–1929.

20. Input the data from the table into a spreadsheet. Compute the serial correlation in decade returns for each asset class and for inflation. Also find the correlation between the returns of various asset classes. What do the data indicate?
21. Convert the asset returns by decade presented in the table into real rates. Repeat the analysis of Challenge Problem 20 for the real rates of return.

The following data apply to CFA Problems 1 through 3: Hennessy & Associates manages a \$30 million equity portfolio for the multimanager Wilstead Pension Fund. Jason Jones, financial vice president of Wilstead, noted that Hennessy had rather consistently achieved the best record among the Wilstead's six equity managers. Performance of the Hennessy portfolio had been clearly superior to that of the S&P 500 in 4 of the past 5 years. In the one less-favorable year, the shortfall was trivial.

Hennessy is a “bottom-up” manager. The firm largely avoids any attempt to “time the market.” It also focuses on selection of individual stocks, rather than the weighting of favored industries.

There is no apparent conformity of style among Wilstead's six equity managers. The five managers, other than Hennessy, manage portfolios aggregating \$250 million made up of more than 150 individual issues.

Jones is convinced that Hennessy is able to apply superior skill to stock selection, but the favorable returns are limited by the high degree of diversification in the portfolio. Over the years, the portfolio generally held 40–50 stocks, with about 2%–3% of total funds committed to each issue. The reason Hennessy seemed to do well most years was that the firm was able to identify each year 10 or 12 issues that registered particularly large gains.

On the basis of this overview, Jones outlined the following plan to the Wilstead pension committee:

Let's tell Hennessy to limit the portfolio to no more than 20 stocks. Hennessy will double the commitments to the stocks that it really favors, and eliminate the remainder. Except for this one new restriction, Hennessy should be free to manage the portfolio exactly as before.

All the members of the pension committee generally supported Jones's proposal because all agreed that Hennessy had seemed to demonstrate superior skill in selecting stocks. Yet the proposal was a considerable departure from previous practice, and several committee members raised questions. Respond to each of the following questions.

1. *a.* Will the limitation to 20 stocks likely increase or decrease the risk of the portfolio? Explain.
- b.* Is there any way Hennessy could reduce the number of issues from 40 to 20 without significantly affecting risk? Explain.



2. One committee member was particularly enthusiastic concerning Jones's proposal. He suggested that Hennessy's performance might benefit further from reduction in the number of issues to 10. If the reduction to 20 could be expected to be advantageous, explain why reduction to 10 might be less likely to be advantageous. (Assume that Wilstead will evaluate the Hennessy portfolio independently of the other portfolios in the fund.)
3. Another committee member suggested that, rather than evaluate each managed portfolio independently of other portfolios, it might be better to consider the effects of a change in the Hennessy portfolio on the total fund. Explain how this broader point of view could affect the committee decision to limit the holdings in the Hennessy portfolio to either 10 or 20 issues.
4. Which one of the following portfolios cannot lie on the efficient frontier as described by Markowitz?

	Portfolio	Expected Return (%)	Standard Deviation (%)
a.	W	15	36
b.	X	12	15
c.	Z	5	7
d.	Y	9	21

5. Which statement about portfolio diversification is correct?
 - a. Proper diversification can reduce or eliminate systematic risk.
 - b. Diversification reduces the portfolio's expected return because it reduces a portfolio's total risk.
 - c. As more securities are added to a portfolio, total risk typically would be expected to fall at a decreasing rate.
 - d. The risk-reducing benefits of diversification do not occur meaningfully until at least 30 individual securities are included in the portfolio.
6. The measure of risk for a security held in a diversified portfolio is:
 - a. Specific risk.
 - b. Standard deviation of returns.
 - c. Reinvestment risk.
 - d. Covariance.
7. Portfolio theory as described by Markowitz is most concerned with:
 - a. The elimination of systematic risk.
 - b. The effect of diversification on portfolio risk.
 - c. The identification of unsystematic risk.
 - d. Active portfolio management to enhance return.
8. Assume that a risk-averse investor owning stock in Miller Corporation decides to add the stock of either Mac or Green Corporation to her portfolio. All three stocks offer the same expected return and total variability. The covariance of return between Miller and Mac is $-.05$ and between Miller and Green is $+.05$. Portfolio risk is expected to:
 - a. Decline more when the investor buys Mac.
 - b. Decline more when the investor buys Green.
 - c. Increase when either Mac or Green is bought.
 - d. Decline or increase, depending on other factors.
9. Stocks A, B, and C have the same expected return and standard deviation. The following table shows the correlations between the returns on these stocks.

	Stock A	Stock B	Stock B
Stock A	+1.0		
Stock B	+0.9	+1.0	
Stock C	+0.1	-0.4	+1.0

Given these correlations, the portfolio constructed from these stocks having the lowest risk is a portfolio:

- Equally invested in stocks *A* and *B*.
 - Equally invested in stocks *A* and *C*.
 - Equally invested in stocks *B* and *C*.
 - Totally invested in stock *C*.
10. Statistics for three stocks, *A*, *B*, and *C*, are shown in the following tables.

Standard Deviations of Returns

Stock:	<i>A</i>	<i>B</i>	<i>C</i>
Standard deviation (%):	40	20	40

Correlations of Returns

Stock	<i>A</i>	<i>B</i>	<i>C</i>
<i>A</i>	1.00	0.90	0.50
<i>B</i>		1.00	0.10
<i>C</i>			1.00

Only on the basis of the information provided in the tables, and given a choice between a portfolio made up of equal amounts of stocks *A* and *B* or a portfolio made up of equal amounts of stocks *B* and *C*, which portfolio would you recommend? Justify your choice.

11. George Stephenson's current portfolio of \$2 million is invested as follows:

Summary of Stephenson's Current Portfolio

	Value	Percent of Total	Expected Annual Return	Annual Standard Deviation
Short-term bonds	\$ 200,000	10%	4.6%	1.6%
Domestic large-cap equities	600,000	30	12.4	19.5
Domestic small-cap equities	1,200,000	60	16.0	29.9
Total portfolio	\$2,000,000	100%	13.8	23.1

Stephenson soon expects to receive an additional \$2 million and plans to invest the entire amount in an index fund that best complements the current portfolio. Stephanie Coppa, CFA, is evaluating the four index funds shown in the following table for their ability to produce a portfolio that will meet two criteria relative to the current portfolio: (1) maintain or enhance expected return and (2) maintain or reduce volatility.

Each fund is invested in an asset class that is not substantially represented in the current portfolio.

Index Fund Characteristics

Index Fund	Expected Annual Return	Expected Annual Standard Deviation	Correlation of Returns with Current Portfolio
Fund <i>A</i>	15%	25%	+0.80
Fund <i>B</i>	11	22	+0.60
Fund <i>C</i>	16	25	+0.90
Fund <i>D</i>	14	22	+0.65

State which fund Coppa should recommend to Stephenson. Justify your choice by describing how your chosen fund *best* meets both of Stephenson's criteria. No calculations are required.

12. Abigail Grace has a \$900,000 fully diversified portfolio. She subsequently inherits ABC Company common stock worth \$100,000. Her financial adviser provided her with the following forecast information:

Risk and Return Characteristics		
	Expected Monthly Returns	Standard Deviation of Monthly Returns
Original Portfolio	0.67%	2.37%
ABC Company	1.25	2.95

The correlation coefficient of ABC stock returns with the original portfolio returns is .40.

- a. The inheritance changes Grace's overall portfolio and she is deciding whether to keep the ABC stock. Assuming Grace keeps the ABC stock, calculate the:
 - i. Expected return of her new portfolio which includes the ABC stock.
 - ii. Covariance of ABC stock returns with the original portfolio returns.
 - iii. Standard deviation of her new portfolio, which includes the ABC stock.
 - b. If Grace sells the ABC stock, she will invest the proceeds in risk-free government securities yielding .42% monthly. Assuming Grace sells the ABC stock and replaces it with the government securities, calculate the
 - i. Expected return of her new portfolio, which includes the government securities.
 - ii. Covariance of the government security returns with the original portfolio returns.
 - iii. Standard deviation of her new portfolio, which includes the government securities.
 - c. Determine whether the systematic risk of her new portfolio, which includes the government securities, will be higher or lower than that of her original portfolio.
 - d. On the basis of conversations with her husband, Grace is considering selling the \$100,000 of ABC stock and acquiring \$100,000 of XYZ Company common stock instead. XYZ stock has the same expected return and standard deviation as ABC stock. Her husband comments, "It doesn't matter whether you keep all of the ABC stock or replace it with \$100,000 of XYZ stock." State whether her husband's comment is correct or incorrect. Justify your response.
 - e. In a recent discussion with her financial adviser, Grace commented, "If I just don't lose money in my portfolio, I will be satisfied." She went on to say, "I am more afraid of losing money than I am concerned about achieving high returns."
 - i. Describe *one* weakness of using standard deviation of returns as a risk measure for Grace.
 - ii. Identify an alternate risk measure that is more appropriate under the circumstances.
13. Dudley Trudy, CFA, recently met with one of his clients. Trudy typically invests in a master list of 30 equities drawn from several industries. As the meeting concluded, the client made the following statement: "I trust your stock-picking ability and believe that you should invest my funds in your five best ideas. Why invest in 30 companies when you obviously have stronger opinions on a few of them?" Trudy plans to respond to his client within the context of modern portfolio theory.
- a. Contrast the concepts of systematic risk and firm-specific risk, and give an example of *each* type of risk.
 - b. Critique the client's suggestion. Discuss how both systematic and firm-specific risk change as the number of securities in a portfolio is increased.

E-INVEST-
MENTS
EXERCISES**Diversification**

Go to the www.investopedia.com/articles/basics/03/050203.asp Web site to learn more about diversification, the factors that influence investors' risk preferences, and the types of investments that fit into each of the risk categories. Then check out www.investopedia.com/articles/pf/05/061505.asp for asset allocation guidelines for various types of portfolios from conservative to very aggressive. What do you conclude about your own risk preferences and the best portfolio type for you? What would you expect to happen to your attitude toward risk as you get older? How might your portfolio composition change?

SOLUTIONS TO CONCEPT CHECKS

1. *a.* The first term will be $w_D \times w_D \times \sigma_D^2$, because this is the element in the top corner of the matrix (σ_D^2) times the term on the column border (w_D) times the term on the row border (w_D). Applying this rule to each term of the covariance matrix results in the sum $w_D^2 \sigma_D^2 + w_D w_E \text{Cov}(r_E, r_D) + w_E w_D \text{Cov}(r_D, r_E) + w_E^2 \sigma_E^2$, which is the same as Equation 7.3, because $\text{Cov}(r_E, r_D) = \text{Cov}(r_D, r_E)$.
- b.* The bordered covariance matrix is

	w_X	w_Y	w_Z
w_X	σ_X^2	$\text{Cov}(r_X, r_Y)$	$\text{Cov}(r_X, r_Z)$
w_Y	$\text{Cov}(r_Y, r_X)$	σ_Y^2	$\text{Cov}(r_Y, r_Z)$
w_Z	$\text{Cov}(r_Z, r_X)$	$\text{Cov}(r_Z, r_Y)$	σ_Z^2

There are nine terms in the covariance matrix. Portfolio variance is calculated from these nine terms:

$$\begin{aligned} \sigma_p^2 &= w_X^2 \sigma_X^2 + w_Y^2 \sigma_Y^2 + w_Z^2 \sigma_Z^2 \\ &\quad + w_X w_Y \text{Cov}(r_X, r_Y) + w_Y w_X \text{Cov}(r_Y, r_X) \\ &\quad + w_X w_Z \text{Cov}(r_X, r_Z) + w_Z w_X \text{Cov}(r_Z, r_X) \\ &\quad + w_Y w_Z \text{Cov}(r_Y, r_Z) + w_Z w_Y \text{Cov}(r_Z, r_Y) \\ &= w_X^2 \sigma_X^2 + w_Y^2 \sigma_Y^2 + w_Z^2 \sigma_Z^2 \\ &\quad + 2w_X w_Y \text{Cov}(r_X, r_Y) + 2w_X w_Z \text{Cov}(r_X, r_Z) + 2w_Y w_Z \text{Cov}(r_Y, r_Z) \end{aligned}$$

2. The parameters of the opportunity set are $E(r_D) = 8\%$, $E(r_E) = 13\%$, $\sigma_D = 12\%$, $\sigma_E = 20\%$, and $\rho(D, E) = .25$. From the standard deviations and the correlation coefficient we generate the covariance matrix:

Fund	D	E
D	144	60
E	60	400

The *global minimum-variance* portfolio is constructed so that

$$\begin{aligned} w_D &= \frac{\sigma_E^2 - \text{Cov}(r_D, r_E)}{\sigma_D^2 + \sigma_E^2 - 2 \text{Cov}(r_D, r_E)} \\ &= \frac{400 - 60}{(144 + 400) - (2 \times 60)} = .8019 \\ w_E &= 1 - w_D = .1981 \end{aligned}$$

Its expected return and standard deviation are

$$\begin{aligned} E(r_P) &= (.8019 \times 8) + (.1981 \times 13) = 8.99\% \\ \sigma_P &= [w_D^2\sigma_D^2 + w_E^2\sigma_E^2 + 2w_Dw_ECov(r_D, r_E)]^{1/2} \\ &= [(.8019^2 \times 144) + (.1981^2 \times 400) + (2 \times .8019 \times .1981 \times 60)]^{1/2} \\ &= 11.29\% \end{aligned}$$

For the other points we simply increase w_D from .10 to .90 in increments of .10; accordingly, w_E ranges from .90 to .10 in the same increments. We substitute these portfolio proportions in the formulas for expected return and standard deviation. Note that when $w_E = 1.0$, the portfolio parameters equal those of the stock fund; when $w_D = 1$, the portfolio parameters equal those of the debt fund.

We then generate the following table:

w_E	w_D	E(r)	σ
0.0	1.0	8.0	12.00
0.1	0.9	8.5	11.46
0.2	0.8	9.0	11.29
0.3	0.7	9.5	11.48
0.4	0.6	10.0	12.03
0.5	0.5	10.5	12.88
0.6	0.4	11.0	13.99
0.7	0.3	11.5	15.30
0.8	0.2	12.0	16.76
0.9	0.1	12.5	18.34
1.0	0.0	13.0	20.00
0.1981	0.8019	8.99	11.29 minimum variance portfolio

You can now draw your graph.

3. a. The computations of the opportunity set of the stock and risky bond funds are like those of Question 2 and will not be shown here. You should perform these computations, however, in order to give a graphical solution to part a. Note that the covariance between the funds is

$$\begin{aligned} Cov(r_A, r_B) &= \rho(A, B) \times \sigma_A \times \sigma_B \\ &= -.2 \times 20 \times 60 = -240 \end{aligned}$$

- b. The proportions in the optimal risky portfolio are given by

$$\begin{aligned} w_A &= \frac{(10 - 5)60^2 - (30 - 5)(-240)}{(10 - 5)60^2 + (30 - 5)20^2 - 30(-240)} \\ &= .6818 \\ w_B &= 1 - w_A = .3182 \end{aligned}$$

The expected return and standard deviation of the optimal risky portfolio are

$$\begin{aligned} E(r_P) &= (.6818 \times 10) + (.3182 \times 30) = 16.36\% \\ \sigma_P &= \{(.6818^2 \times 20^2) + (.3182^2 \times 60^2) + [2 \times .6818 \times .3182(-240)]\}^{1/2} \\ &= 21.13\% \end{aligned}$$

Note that portfolio P is not the global minimum-variance portfolio. The proportions of the latter are given by

$$\begin{aligned} w_A &= \frac{60^2 - (-240)}{60^2 + 20^2 - 2(-240)} = .8571 \\ w_B &= 1 - w_A = .1429 \end{aligned}$$

With these proportions, the standard deviation of the minimum-variance portfolio is

$$\begin{aligned}\sigma(\min) &= (.8571^2 \times 20^2) + (.1429^2 \times 60^2) + [2 \times .8571 \times .1429 \times (-240)]^{1/2} \\ &= 17.57\%\end{aligned}$$

which is less than that of the optimal risky portfolio.

- c. The CAL is the line from the risk-free rate through the optimal risky portfolio. This line represents all efficient portfolios that combine T-bills with the optimal risky portfolio. The slope of the CAL is

$$S = \frac{E(r_p) - r_f}{\sigma_p} = \frac{16.36 - 5}{21.13} = .5376$$

- d. Given a degree of risk aversion, A , an investor will choose a proportion, y , in the optimal risky portfolio of (remember to express returns as decimals when using A):

$$y = \frac{E(r_p) - r_f}{A\sigma_p^2} = \frac{.1636 - .05}{5 \times .2113^2} = .5089$$

This means that the optimal risky portfolio, with the given data, is attractive enough for an investor with $A = 5$ to invest 50.89% of his or her wealth in it. Because stock A makes up 68.18% of the risky portfolio and stock B makes up 31.82%, the investment proportions for this investor are

Stock A:	$.5089 \times 68.18 = 34.70\%$
Stock B:	$.5089 \times 31.82 = 16.19\%$
Total	50.89%

4. Efficient frontiers derived by portfolio managers depend on forecasts of the rates of return on various securities and estimates of risk, that is, the covariance matrix. The forecasts themselves do not control outcomes. Thus preferring managers with rosier forecasts (northwesterly frontiers) is tantamount to rewarding the bearers of good news and punishing the bearers of bad news. What we should do is reward bearers of *accurate* news. Thus if you get a glimpse of the frontiers (forecasts) of portfolio managers on a regular basis, what you want to do is develop the track record of their forecasting accuracy and steer your advisees toward the more accurate forecaster. Their portfolio choices will, in the long run, outperform the field.
5. The parameters are $E(r) = 15$, $\sigma = 60$, and the correlation between any pair of stocks is $\rho = .5$.

- a. The portfolio expected return is invariant to the size of the portfolio because all stocks have identical expected returns. The standard deviation of a portfolio with $n = 25$ stocks is

$$\begin{aligned}\sigma_p &= [\sigma^2/n + \rho \times \sigma^2(n-1)/n]^{1/2} \\ &= [60^2/25 + .5 \times 60^2 \times 24/25]^{1/2} = 43.27\%\end{aligned}$$

- b. Because the stocks are identical, efficient portfolios are equally weighted. To obtain a standard deviation of 43%, we need to solve for n :

$$\begin{aligned}43^2 &= \frac{60^2}{n} + .5 \times \frac{60^2(n-1)}{n} \\ 1,849n &= 3,600 + 1,800n - 1,800 \\ n &= \frac{1,800}{49} = 36.73\end{aligned}$$

Thus we need 37 stocks and will come in with volatility slightly under the target.

- c. As n gets very large, the variance of an efficient (equally weighted) portfolio diminishes, leaving only the variance that comes from the covariances among stocks, that is

$$\sigma_p = \sqrt{\rho \times \sigma^2} = \sqrt{.5 \times 60^2} = 42.43\%$$

Note that with 25 stocks we came within .84% of the systematic risk, that is, the nonsystematic risk of a portfolio of 25 stocks is only .84%. With 37 stocks the standard deviation is 43%, of which nonsystematic risk is .57%.

- d. If the risk-free is 10%, then the risk premium on any size portfolio is $15 - 10 = 5\%$. The standard deviation of a well-diversified portfolio is (practically) 42.43%; hence the slope of the CAL is

$$S = 5/42.43 = .1178$$

APPENDIX A: A Spreadsheet Model for Efficient Diversification

Several software packages can be used to generate the efficient frontier. We will demonstrate the method using Microsoft Excel. Excel is far from the best program for this purpose and is limited in the number of assets it can handle, but working through a simple portfolio optimizer in Excel can illustrate concretely the nature of the calculations used in more sophisticated “black-box” programs. You will find that even in Excel, the computation of the efficient frontier is fairly easy.

We apply the Markowitz portfolio optimization program to a practical problem of international diversification. We take the perspective of a portfolio manager serving U.S. clients, who wishes to construct for the next year an optimal risky portfolio of large stocks in the U.S and six developed capital markets (Japan, Germany, U.K., France, Canada, and Australia). First we describe the input list: forecasts of risk premiums and the covariance matrix. Next, we describe Excel’s Solver, and finally we show the solution to the manager’s problem.

The Covariance Matrix

To capture recent risk parameters the manager compiles an array of 60 recent monthly (annualized) rates of return, as well as the monthly T-bill rates for the same period.

The standard deviations of excess returns are shown in Table 7A.1 (column C). They range from 14.93% (U.K. large stocks) to 22.7% (Germany). For perspective on how these parameters can change over time, standard deviations for the period 1991–2000 are also shown (column B). In addition, we present the correlation coefficient between large stocks in the six foreign markets with U.S. large stocks for the same two periods. Here we see that correlations are higher in the more recent period, consistent with the process of globalization.

The covariance matrix shown in Table 7A.2 was estimated from the array of 60 returns of the seven countries using the COVARIANCE function from the dialog box of *Data Analysis* in Excel’s Tools menu. Due to a quirk in the Excel software, the covariance matrix is not corrected for degrees-of-freedom bias; hence, each of the elements in the matrix was multiplied by 60/59 to eliminate downward bias.

Expected Returns

While estimation of the risk parameters (the covariance matrix) from excess returns is a simple technical matter, estimating the risk premium (the expected excess return) is a daunting task. As we discussed in Chapter 5, estimating expected returns using historical data is unreliable. Consider, for example, the negative average excess returns on U.S. large stocks over the period 2001–2005 (cell G6) and, more generally, the big differences in average returns between the 1991–2000 and 2001–2005 periods, as demonstrated in columns F and G.

simple version of the expected return–beta relationship holds. But if those distributions change unpredictably, or if investors seek to hedge nonmarket sources of risk to their consumption, the simple CAPM will give way to a multifactor version in which the security’s exposure to these nonmarket sources of risk command risk premiums.

9. The consumption-based capital asset pricing model (CCAPM) is a single-factor model in which the market portfolio excess return is replaced by that of a consumption-tracking portfolio. By appealing directly to consumption, the model naturally incorporates consumption-hedging considerations and changing investment opportunities within a single-factor framework.
10. The security market line of the CAPM must be modified to account for labor income and other significant nontraded assets.
11. Liquidity costs and liquidity risk can be incorporated into the CAPM relationship. Investors demand compensation for expected costs of illiquidity as well as the risk surrounding those costs.

Related Web sites for this chapter are available at www.mhhe.com/bkm

homogeneous expectations
market portfolio
mutual fund theorem
market price of risk
beta

expected return–beta relationship
security market line (SML)
alpha
market model

zero-beta portfolio
liquidity
illiquidity

KEY TERMS

1. What must be the beta of a portfolio with $E(r_p) = 18\%$, if $r_f = 6\%$ and $E(r_M) = 14\%$?
2. The market price of a security is \$50. Its expected rate of return is 14%. The risk-free rate is 6% and the market risk premium is 8.5%. What will be the market price of the security if its correlation coefficient with the market portfolio doubles (and all other variables remain unchanged)? Assume that the stock is expected to pay a constant dividend in perpetuity.
3. Are the following true or false? Explain.
 - a. Stocks with a beta of zero offer an expected rate of return of zero.
 - b. The CAPM implies that investors require a higher return to hold highly volatile securities.
 - c. You can construct a portfolio with beta of .75 by investing .75 of the investment budget in T-bills and the remainder in the market portfolio.
4. Here are data on two companies. The T-bill rate is 4% and the market risk premium is 6%.

Company	\$1 Discount Store	Everything \$5
Forecasted return	12%	11%
Standard deviation of returns	8%	10%
Beta	1.5	1.0

What would be the fair return for each company, according to the capital asset pricing model (CAPM)?

5. Characterize each company in the previous problem as underpriced, overpriced, or properly priced.
6. What is the expected rate of return for a stock that has a beta of 1.0 if the expected return on the market is 15%?
 - a. 15%.
 - b. More than 15%.
 - c. Cannot be determined without the risk-free rate.

PROBLEM SETS

i. Basic





ii. Intermediate

7. Kaskin, Inc., stock has a beta of 1.2 and Quinn, Inc., stock has a beta of .6. Which of the following statements is *most* accurate?
- The expected rate of return will be higher for the stock of Kaskin, Inc., than that of Quinn, Inc.
 - The stock of Kaskin, Inc., has more total risk than Quinn, Inc.
 - The stock of Quinn, Inc., has more systematic risk than that of Kaskin, Inc.

8. You are a consultant to a large manufacturing corporation that is considering a project with the following net after-tax cash flows (in millions of dollars):

Years from Now	After-Tax Cash Flow
0	-40
1-10	15

The project's beta is 1.8. Assuming that $r_f = 8\%$ and $E(r_M) = 16\%$, what is the net present value of the project? What is the highest possible beta estimate for the project before its NPV becomes negative?

9. Consider the following table, which gives a security analyst's expected return on two stocks for two particular market returns:

Market Return	Aggressive Stock	Defensive Stock
5%	-2%	6%
25	38	12

- What are the betas of the two stocks?
- What is the expected rate of return on each stock if the market return is equally likely to be 5% or 25%?
- If the T-bill rate is 6% and the market return is equally likely to be 5% or 25%, draw the SML for this economy.
- Plot the two securities on the SML graph. What are the alphas of each?
- What hurdle rate should be used by the management of the aggressive firm for a project with the risk characteristics of the defensive firm's stock?

For Problems 10 to 16: If the simple CAPM is valid, which of the following situations are possible? Explain. Consider each situation independently.

10.

Portfolio	Expected Return	Beta
A	20	1.4
B	25	1.2

11.

Portfolio	Expected Return	Standard Deviation
A	30	35
B	40	25

12.

Portfolio	Expected Return	Standard Deviation
Risk-free	10	0
Market	18	24
A	16	12

13.

Portfolio	Expected Return	Standard Deviation
Risk-free	10	0
Market	18	24
A	20	22

14. Portfolio	Expected Return	Beta
Risk-free	10	0
Market	18	1.0
A	16	1.5

15. Portfolio	Expected Return	Beta
Risk-free	10	0
Market	18	1.0
A	16	0.9

16. Portfolio	Expected Return	Standard Deviation
Risk-free	10	0
Market	18	24
A	16	22

For Problems 17 to 19 assume that the risk-free rate of interest is 6% and the expected rate of return on the market is 16%.

17. A share of stock sells for \$50 today. It will pay a dividend of \$6 per share at the end of the year. Its beta is 1.2. What do investors expect the stock to sell for at the end of the year?
18. I am buying a firm with an expected perpetual cash flow of \$1,000 but am unsure of its risk. If I think the beta of the firm is .5, when in fact the beta is really 1, how much *more* will I offer for the firm than it is truly worth?
19. A stock has an expected rate of return of 4%. What is its beta?
20. Two investment advisers are comparing performance. One averaged a 19% rate of return and the other a 16% rate of return. However, the beta of the first investor was 1.5, whereas that of the second was 1.
 - a. Can you tell which investor was a better selector of individual stocks (aside from the issue of general movements in the market)?
 - b. If the T-bill rate were 6% and the market return during the period were 14%, which investor would be the superior stock selector?
 - c. What if the T-bill rate were 3% and the market return were 15%?
21. Suppose the rate of return on short-term government securities (perceived to be risk-free) is about 5%. Suppose also that the expected rate of return required by the market for a portfolio with a beta of 1 is 12%. According to the capital asset pricing model:
 - a. What is the expected rate of return on the market portfolio?
 - b. What would be the expected rate of return on a stock with $\beta = 0$?
 - c. Suppose you consider buying a share of stock at \$40. The stock is expected to pay \$3 dividends next year and you expect it to sell then for \$41. The stock risk has been evaluated at $\beta = -.5$. Is the stock overpriced or underpriced?
22. Suppose that borrowing is restricted so that the zero-beta version of the CAPM holds. The expected return on the market portfolio is 17%, and on the zero-beta portfolio it is 8%. What is the expected return on a portfolio with a beta of .6?
23.
 - a. A mutual fund with beta of .8 has an expected rate of return of 14%. If $r_f = 5\%$, and you expect the rate of return on the market portfolio to be 15%, should you invest in this fund? What is the fund's alpha?
 - b. What passive portfolio comprised of a market-index portfolio and a money market account would have the same beta as the fund? Show that the difference between the expected rate of return on this passive portfolio and that of the fund equals the alpha from part (a).
24. Outline how you would incorporate the following into the CCAPM:
 - a. Liquidity.
 - b. Nontraded assets. (Do you have to worry about labor income?)

iii. Challenge



1. a. John Wilson is a portfolio manager at Austin & Associates. For all of his clients, Wilson manages portfolios that lie on the Markowitz efficient frontier. Wilson asks Mary Regan, CFA, a managing director at Austin, to review the portfolios of two of his clients, the Eagle Manufacturing Company and the Rainbow Life Insurance Co. The expected returns of the two portfolios are substantially different. Regan determines that the Rainbow portfolio is virtually identical to the market portfolio and concludes that the Rainbow portfolio must be superior to the Eagle portfolio. Do you agree or disagree with Regan's conclusion that the Rainbow portfolio is superior to the Eagle portfolio? Justify your response with reference to the capital market line.
 - b. Wilson remarks that the Rainbow portfolio has a higher expected return because it has greater nonsystematic risk than Eagle's portfolio. Define nonsystematic risk and explain why you agree or disagree with Wilson's remark.
2. Wilson is now evaluating the expected performance of two common stocks, Furchman Labs Inc. and Garten Testing Inc. He has gathered the following information:
 - The risk-free rate is 5%.
 - The expected return on the market portfolio is 11.5%.
 - The beta of Furchman stock is 1.5.
 - The beta of Garten stock is .8.

Based on his own analysis, Wilson's forecasts of the returns on the two stocks are 13.25% for Furchman stock and 11.25% for Garten stock. Calculate the required rate of return for Furchman Labs stock and for Garten Testing stock. Indicate whether each stock is undervalued, fairly valued, or overvalued.

3. The security market line depicts:
 - a. A security's expected return as a function of its systematic risk.
 - b. The market portfolio as the optimal portfolio of risky securities.
 - c. The relationship between a security's return and the return on an index.
 - d. The complete portfolio as a combination of the market portfolio and the risk-free asset.
4. Within the context of the capital asset pricing model (CAPM), assume:
 - Expected return on the market = 15%.
 - Risk-free rate = 8%.
 - Expected rate of return on XYZ security = 17%.
 - Beta of XYZ security = 1.25.

Which one of the following is correct?

 - a. XYZ is overpriced.
 - b. XYZ is fairly priced.
 - c. XYZ's alpha is $-.25\%$.
 - d. XYZ's alpha is $.25\%$.
5. What is the expected return of a zero-beta security?
 - a. Market rate of return.
 - b. Zero rate of return.
 - c. Negative rate of return.
 - d. Risk-free rate of return.
6. Capital asset pricing theory asserts that portfolio returns are best explained by:
 - a. Economic factors.
 - b. Specific risk.
 - c. Systematic risk.
 - d. Diversification.
7. According to CAPM, the expected rate of return of a portfolio with a beta of 1.0 and an alpha of 0 is:
 - a. Between r_M and r_f .
 - b. The risk-free rate, r_f .
 - c. $\beta(r_M - r_f)$.
 - d. The expected return on the market, r_M .

The following table shows risk and return measures for two portfolios.

Portfolio	Average Annual Rate of Return	Standard Deviation	Beta
<i>R</i>	11%	10%	0.5
S&P 500	14%	12%	1.0

8. When plotting portfolio *R* on the preceding table relative to the SML, portfolio *R* lies:
 - a. On the SML.
 - b. Below the SML.
 - c. Above the SML.
 - d. Insufficient data given.
9. When plotting portfolio *R* relative to the capital market line, portfolio *R* lies:
 - a. On the CML.
 - b. Below the CML.
 - c. Above the CML.
 - d. Insufficient data given.
10. Briefly explain whether investors should expect a higher return from holding portfolio *A* versus portfolio *B* under capital asset pricing theory (CAPM). Assume that both portfolios are fully diversified.

	Portfolio A	Portfolio B
Systematic risk (beta)	1.0	1.0
Specific risk for each individual security	High	Low

11. Joan McKay is a portfolio manager for a bank trust department. McKay meets with two clients, Kevin Murray and Lisa York, to review their investment objectives. Each client expresses an interest in changing his or her individual investment objectives. Both clients currently hold well-diversified portfolios of risky assets.
 - a. Murray wants to increase the expected return of his portfolio. State what action McKay should take to achieve Murray's objective. Justify your response in the context of the CML.
 - b. York wants to reduce the risk exposure of her portfolio but does not want to engage in borrowing or lending activities to do so. State what action McKay should take to achieve York's objective. Justify your response in the context of the SML.
12. Karen Kay, a portfolio manager at Collins Asset Management, is using the capital asset pricing model for making recommendations to her clients. Her research department has developed the information shown in the following exhibit.

Forecast Returns, Standard Deviations, and Betas

	Forecast Return	Standard Deviation	Beta
Stock <i>X</i>	14.0%	36%	0.8
Stock <i>Y</i>	17.0	25	1.5
Market index	14.0	15	1.0
Risk-free rate	5.0		

- a. Calculate expected return and alpha for each stock.
- b. Identify and justify which stock would be more appropriate for an investor who wants to
 - i. add this stock to a well-diversified equity portfolio.
 - ii. hold this stock as a single-stock portfolio.

E-INVEST- MENTS EXERCISES

Beta and Security Returns

Fidelity provides data on the risk and return of its funds at www.fidelity.com. Click on the *Research* link, then choose *Mutual Funds* from the submenu. In the *Fund Evaluator* section, choose *Advanced Search*. Scroll down until you find the *Risk/ Volatility Measures* section and indicate that you want to screen for funds with betas less than or equal to .50. Click *Search Funds* to see the results. Click on the link that says *View All Matching Fidelity Funds*. Select five funds from the resulting list and click *Compare*. Rank the five funds according to their betas and then according to their standard deviations. Do both lists rank the funds in the same order? How would you explain any difference in the rankings? Note the 1-Year return for one of the funds (use the load-adjusted return if it is available). Repeat the exercise to compare five funds that have betas greater than or equal to 1.50.

SOLUTIONS TO CONCEPT CHECKS

- We can characterize the entire population by two representative investors. One is the “uninformed” investor, who does not engage in security analysis and holds the market portfolio, whereas the other optimizes using the Markowitz algorithm with input from security analysis. The uninformed investor does not know what input the informed investor uses to make portfolio purchases. The uninformed investor knows, however, that if the other investor is informed, the market portfolio proportions will be optimal. Therefore, to depart from these proportions would constitute an uninformed bet, which will, on average, reduce the efficiency of diversification with no compensating improvement in expected returns.

- Substituting the historical mean and standard deviation in Equation 9.2 yields a coefficient of risk aversion of

$$\bar{A} = \frac{E(r_M) - r_f}{\sigma_M^2} = \frac{.079}{.232^2} = 1.47$$

- This relationship also tells us that for the historical standard deviation and a coefficient of risk aversion of 3.5 the risk premium would be

$$E(r_M) - r_f = \bar{A}\sigma_M^2 = 3.5 \times .232^2 = .188 = 18.8\%$$

- For these investment proportions, w_{Ford} , w_{Toyota} , the portfolio β is

$$\begin{aligned}\beta_P &= w_{\text{Ford}}\beta_{\text{Ford}} + w_{\text{Toyota}}\beta_{\text{Toyota}} \\ &= (.75 \times 1.25) + (.25 \times 1.10) = 1.2125\end{aligned}$$

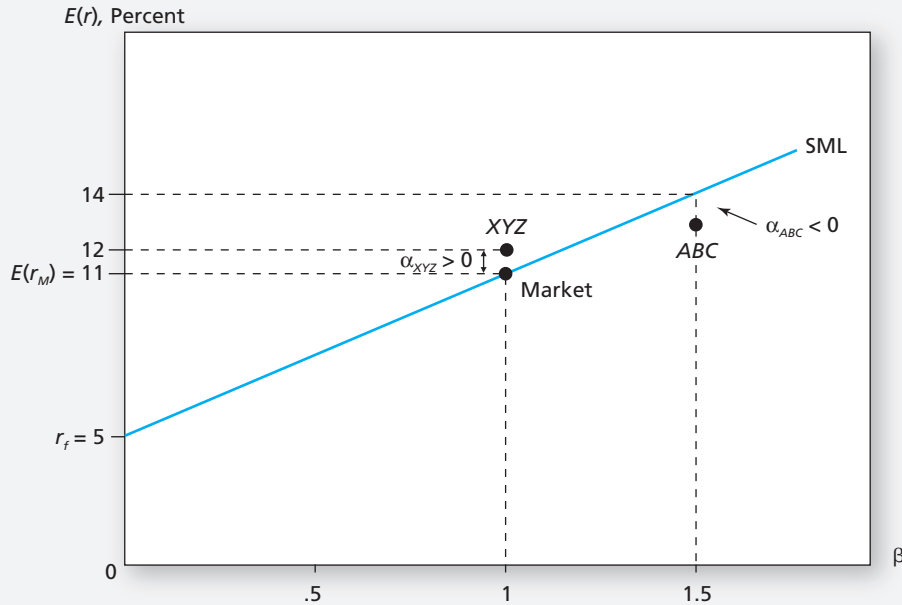
As the market risk premium, $E(r_M) - r_f$, is 8%, the portfolio risk premium will be

$$\begin{aligned}E(r_P) - r_f &= \beta_P[E(r_M) - r_f] \\ &= 1.2125 \times 8 = 9.7\%\end{aligned}$$

- The alpha of a stock is its expected return in excess of that required by the CAPM.

$$\begin{aligned}\alpha &= E(r) - \{r_f + \beta[E(r_M) - r_f]\} \\ \alpha_{XYZ} &= 12 - [5 + 1.0(11 - 5)] = 1\% \\ \alpha_{ABC} &= 13 - [5 + 1.5(11 - 5)] = -1\%\end{aligned}$$

ABC plots below the SML, while XYZ plots above.



5. The project-specific required return is determined by the project beta coupled with the market risk premium and the risk-free rate. The CAPM tells us that an acceptable expected rate of return for the project is

$$r_f + \beta[E(r_M) - r_f] = 8 + 1.3(16 - 8) = 18.4\%$$

which becomes the project's hurdle rate. If the IRR of the project is 19%, then it is desirable. Any project with an IRR equal to or less than 18.4% should be rejected.

6. The CAPM is a model that relates expected rates of return to risk. It results in the expected return–beta relationship, where the expected risk premium on any asset is proportional to the expected risk premium on the market portfolio with beta as the proportionality constant. As such, the model is impractical for two reasons: (i) expectations are unobservable, and (ii) the theoretical market portfolio includes every risky asset and is in practice unobservable. The next three models incorporate additional assumptions to overcome these problems.

The single-factor model assumes that one economic factor, denoted F , exerts the only common influence on security returns. Beyond it, security returns are driven by independent, firm-specific factors. Thus for any security, i ,

$$r_i = E(r_i) + \beta_i F + e_i$$

The single-index model assumes that in the single-factor model, the factor F can be replaced by a broad-based index of securities that can proxy for the CAPM's theoretical market portfolio. The index model can be stated as $R_i = \alpha_i + \beta_i R_M + e_i$.

At this point it should be said that many interchange the meaning of the index and market models. The concept of the market model is that rate of return *surprises* on a stock are proportional to corresponding surprises on the market index portfolio, again with proportionality constant β .

They expend resources neither on market research nor on frequent purchase and sale of stocks. Passive strategies may be tailored to meet individual investor requirements.

5. Event studies are used to evaluate the economic impact of events of interest, using abnormal stock returns. Such studies usually show that there is some leakage of inside information to some market participants before the public announcement date. Therefore, insiders do seem to be able to exploit their access to information to at least a limited extent.
6. Empirical studies of technical analysis do not generally support the hypothesis that such analysis can generate superior trading profits. One notable exception to this conclusion is the apparent success of momentum-based strategies over intermediate-term horizons.
7. Several anomalies regarding fundamental analysis have been uncovered. These include the P/E effect, the small-firm-in-January effect, the neglected-firm effect, post-earnings-announcement price drift, and the book-to-market effect. Whether these anomalies represent market inefficiency or poorly understood risk premiums is still a matter of debate.
8. By and large, the performance record of professionally managed funds lends little credence to claims that most professionals can consistently beat the market.

Related Web sites for this chapter are available at www.mhhe.com/bkm

KEY TERMS

random walk	support levels	momentum effect
efficient market hypothesis	fundamental analysis	reversal effect
weak-form EMH	passive investment strategy	anomalies
semistrong-form EMH	index fund	P/E effect
strong-form EMH	event study	small-firm effect
technical analysis	abnormal return	neglected-firm effect
resistance levels	cumulative abnormal return	book-to-market effect

PROBLEM SETS

i. Basic

1. If markets are efficient, what should be the correlation coefficient between stock returns for two non-overlapping time periods?
2. A successful firm like Microsoft has consistently generated large profits for years. Is this a violation of the EMH?
3. “If all securities are fairly priced, all must offer equal expected rates of return.” Comment.
4. Steady Growth Industries has never missed a dividend payment in its 94-year history. Does this make it more attractive to you as a possible purchase for your stock portfolio?
5. At a cocktail party, your co-worker tells you that he has beaten the market for each of the last 3 years. Suppose you believe him. Does this shake your belief in efficient markets?
6. “Highly variable stock prices suggest that the market does not know how to price stocks.” Comment.
7. Why are the following “effects” considered efficient market anomalies? Are there rational explanations for any of these effects?
 - a. P/E effect.
 - b. Book-to-market effect.
 - c. Momentum effect.
 - d. Small-firm effect.

ii. Intermediate

9. Which of the following most appears to contradict the proposition that the stock market is *weakly* efficient? Explain.
 - a. Over 25% of mutual funds outperform the market on average.
 - b. Insiders earn abnormal trading profits.
 - c. Every January, the stock market earns abnormal returns.



10. Which of the following sources of market inefficiency would be most easily exploited?
- A stock price drops suddenly due to a large block sale by an institution.
 - A stock is overpriced because traders are restricted from short sales.
 - Stocks are overvalued because investors are exuberant over increased productivity in the economy.
11. Suppose that, after conducting an analysis of past stock prices, you come up with the following observations. Which would appear to *contradict* the *weak form* of the efficient market hypothesis? Explain.
- The average rate of return is significantly greater than zero.
 - The correlation between the return during a given week and the return during the following week is zero.
 - One could have made superior returns by buying stock after a 10% rise in price and selling after a 10% fall.
 - One could have made higher-than-average capital gains by holding stocks with low dividend yields.
12. Which of the following statements are true if the efficient market hypothesis holds?
- It implies that future events can be forecast with perfect accuracy.
 - It implies that prices reflect all available information.
 - It implies that security prices change for no discernible reason.
 - It implies that prices do not fluctuate.
13. Respond to each of the following comments.
- If stock prices follow a random walk, then capital markets are little different from a casino.
 - A good part of a company's future prospects are predictable. Given this fact, stock prices can't possibly follow a random walk.
 - If markets are efficient, you might as well select your portfolio by throwing darts at the stock listings in *The Wall Street Journal*.
14. Which of the following would be a viable way to earn abnormally high trading profits if markets are semistrong-form efficient?
- Buy shares in companies with low P/E ratios.
 - Buy shares in companies with recent above-average price changes.
 - Buy shares in companies with recent below-average price changes.
 - Buy shares in companies for which you have advance knowledge of an improvement in the management team.
15. Suppose you find that prices of stocks before large dividend increases show on average consistently positive abnormal returns. Is this a violation of the EMH?
16. "If the business cycle is predictable, and a stock has a positive beta, the stock's returns also must be predictable." Respond.
17. Which of the following phenomena would be either consistent with or a violation of the efficient market hypothesis? Explain briefly.
- Nearly half of all professionally managed mutual funds are able to outperform the S&P 500 in a typical year.
 - Money managers that outperform the market (on a risk-adjusted basis) in one year are likely to outperform in the following year.
 - Stock prices tend to be predictably more volatile in January than in other months.
 - Stock prices of companies that announce increased earnings in January tend to outperform the market in February.
 - Stocks that perform well in one week perform poorly in the following week.
18. An index model regression applied to past monthly returns in Ford's stock price produces the following estimates, which are believed to be stable over time:

$$r_F = .10\% + 1.1r_M$$

If the market index subsequently rises by 8% and Ford's stock price rises by 7%, what is the abnormal change in Ford's stock price?

19. The monthly rate of return on T-bills is 1%. The market went up this month by 1.5%. In addition, AmbChaser, Inc., which has an equity beta of 2, surprisingly just won a lawsuit that awards it \$1 million immediately.
- If the original value of AmbChaser equity were \$100 million, what would you guess was the rate of return of its stock this month?
 - What is your answer to (a) if the market had expected AmbChaser to win \$2 million?
20. In a recent closely contested lawsuit, Apex sued Bpex for patent infringement. The jury came back today with its decision. The rate of return on Apex was $r_A = 3.1\%$. The rate of return on Bpex was only $r_B = 2.5\%$. The market today responded to very encouraging news about the unemployment rate, and $r_M = 3\%$. The historical relationship between returns on these stocks and the market portfolio has been estimated from index model regressions as:

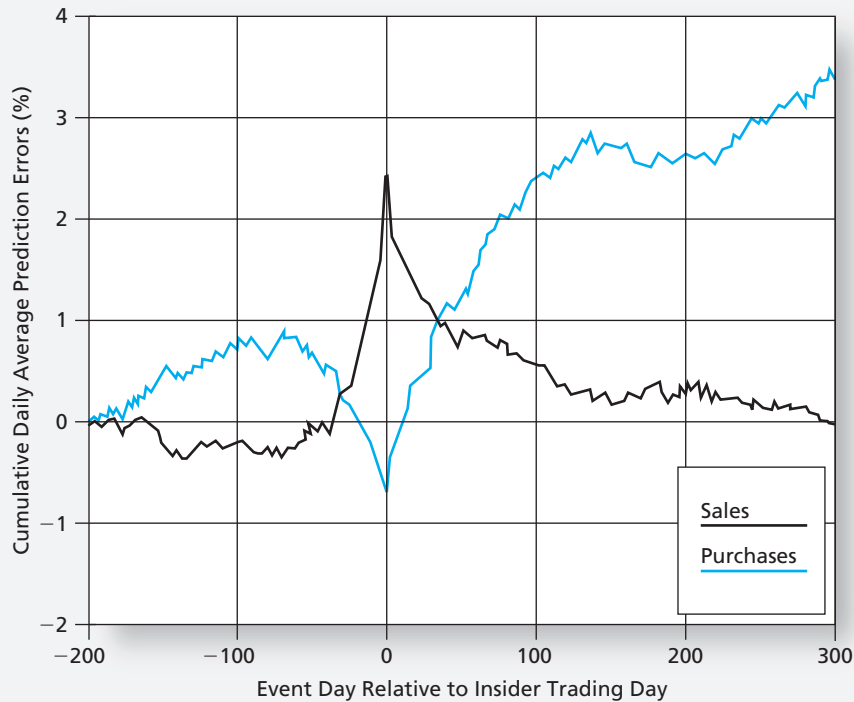
$$\text{Apex: } r_A = .2\% + 1.4r_M$$

$$\text{Bpex: } r_B = -.1\% + .6r_M$$

On the basis of these data, which company do you think won the lawsuit?

21. Investors *expect* the market rate of return in the coming year to be 12%. The T-bill rate is 4%. Changing Fortunes Industries' stock has a beta of .5. The market value of its outstanding equity is \$100 million.
- What is your best guess currently as to the expected rate of return on Changing Fortunes' stock? You believe that the stock is fairly priced.
 - If the market return in the coming year actually turns out to be 10%, what is your best guess as to the rate of return that will be earned on Changing Fortunes' stock?
 - Suppose now that Changing Fortunes wins a major lawsuit during the year. The settlement is \$5 million. Changing Fortunes' stock return during the year turns out to be 10%. What is your best guess as to the settlement the market previously *expected* Changing Fortunes to receive from the lawsuit? (Continue to assume that the market return in the year turned out to be 10%.) The magnitude of the settlement is the only unexpected firm-specific event during the year.
22. Dollar-cost averaging means that you buy equal dollar amounts of a stock every period, for example, \$500 per month. The strategy is based on the idea that when the stock price is low, your fixed monthly purchase will buy more shares, and when the price is high, fewer shares. Averaging over time, you will end up buying more shares when the stock is cheaper and fewer when it is relatively expensive. Therefore, by design, you will exhibit good market timing. Evaluate this strategy.
23. We know that the market should respond positively to good news and that good-news events such as the coming end of a recession can be predicted with at least some accuracy. Why, then, can we not predict that the market will go up as the economy recovers?
24. You know that firm XYZ is very poorly run. On a scale of 1 (worst) to 10 (best), you would give it a score of 3. The market consensus evaluation is that the management score is only 2. Should you buy or sell the stock?
25. Suppose that during a certain week the Fed announces a new monetary growth policy, Congress surprisingly passes legislation restricting imports of foreign automobiles, and Ford comes out with a new car model that it believes will increase profits substantially. How might you go about measuring the market's assessment of Ford's new model?
26. Good News, Inc., just announced an increase in its annual earnings, yet its stock price fell. Is there a rational explanation for this phenomenon?
- iii. Challenge
27. Shares of small firms with thinly traded stocks tend to show positive CAPM alphas. Is this a violation of the efficient market hypothesis?
28. Examine the accompanying figure,⁵⁶ which presents cumulative abnormal returns both before and after dates on which insiders buy or sell shares in their firms. How do you interpret this figure? What are we to make of the pattern of CARs before and after the event date?

⁵⁶Reprinted from Nejat H. Seyhun, "Insiders, Profits, Costs of Trading and Market Efficiency," *Journal of Financial Economics* 16 (1986). Copyright 1986 with permission from Elsevier Science.



29. Suppose that as the economy moves through a business cycle, risk premiums also change. For example, in a recession when people are concerned about their jobs, risk tolerance might be lower and risk premiums might be higher. In a booming economy, tolerance for risk might be higher and premiums lower.
- Would a predictably shifting risk premium such as described here be a violation of the efficient market hypothesis?
 - How might a cycle of increasing and decreasing risk premiums create an appearance that stock prices “overreact,” first falling excessively and then seeming to recover?
- The semistrong form of the efficient market hypothesis asserts that stock prices:
 - Fully reflect all historical price information.
 - Fully reflect all publicly available information.
 - Fully reflect all relevant information, including insider information.
 - May be predictable.
 - Assume that a company announces an unexpectedly large cash dividend to its shareholders. In an efficient market *without* information leakage, one might expect:
 - An abnormal price change at the announcement.
 - An abnormal price increase before the announcement.
 - An abnormal price decrease after the announcement.
 - No abnormal price change before or after the announcement.
 - Which one of the following would provide evidence *against* the *semistrong form* of the efficient market theory?
 - About 50% of pension funds outperform the market in any year.
 - All investors have learned to exploit signals about future performance.
 - Trend analysis is worthless in determining stock prices.
 - Low P/E stocks tend to have positive abnormal returns over the long run.



4. According to the efficient market hypothesis:
 - a. High-beta stocks are consistently overpriced.
 - b. Low-beta stocks are consistently overpriced.
 - c. Positive alphas on stocks will quickly disappear.
 - d. Negative alpha stocks consistently yield low returns for arbitrageurs.
5. A “random walk” occurs when:
 - a. Stock price changes are random but predictable.
 - b. Stock prices respond slowly to both new and old information.
 - c. Future price changes are uncorrelated with past price changes.
 - d. Past information is useful in predicting future prices.
6. Two basic assumptions of technical analysis are that security prices adjust:
 - a. Gradually to new information, and study of the economic environment provides an indication of future market movements.
 - b. Rapidly to new information, and study of the economic environment provides an indication of future market movements.
 - c. Rapidly to new information, and market prices are determined by the interaction between supply and demand.
 - d. Gradually to new information, and prices are determined by the interaction between supply and demand.
7. When technical analysts say a stock has good “relative strength,” they mean:
 - a. The ratio of the price of the stock to a market or industry index has trended upward.
 - b. The recent trading volume in the stock has exceeded the normal trading volume.
 - c. The total return on the stock has exceeded the total return on T-bills.
 - d. The stock has performed well recently compared to its past performance.
8. Your investment client asks for information concerning the benefits of active portfolio management. She is particularly interested in the question of whether active managers can be expected to consistently exploit inefficiencies in the capital markets to produce above-average returns without assuming higher risk.

The semistrong form of the efficient market hypothesis asserts that all publicly available information is rapidly and correctly reflected in securities prices. This implies that investors cannot expect to derive above-average profits from purchases made after information has become public because security prices already reflect the information’s full effects.

 - a. Identify and explain two examples of empirical evidence that tend to support the EMH implication stated above.
 - b. Identify and explain two examples of empirical evidence that tend to refute the EMH implication stated above.
 - c. Discuss reasons why an investor might choose not to index even if the markets were, in fact, semistrong-form efficient.
9.
 - a. Briefly explain the concept of the efficient market hypothesis (EMH) and each of its three forms—weak, semistrong, and strong—and briefly discuss the degree to which existing empirical evidence supports each of the three forms of the EMH.
 - b. Briefly discuss the implications of the efficient market hypothesis for investment policy as it applies to:
 - i. Technical analysis in the form of charting.
 - ii. Fundamental analysis.
 - c. Briefly explain the roles or responsibilities of portfolio managers in an efficient market environment.
10. Growth and value can be defined in several ways. “Growth” usually conveys the idea of a portfolio emphasizing or including only issues believed to possess above-average future rates of per-share earnings growth. Low current yield, high price-to-book ratios, and high price-to-earnings ratios are typical characteristics of such portfolios. “Value” usually conveys the idea of

portfolios emphasizing or including only issues currently showing low price-to-book ratios, low price-to-earnings ratios, above-average levels of dividend yield, and market prices believed to be below the issues' intrinsic values.

- a. Identify and provide reasons why, over an extended period of time, value-stock investing might outperform growth-stock investing.
- b. Explain why the outcome suggested in (a) should not be possible in a market widely regarded as being highly efficient.

Earnings Surprises

Several Web sites list information on earnings surprises. Much of the information supplied is from **Zacks.com**. Each day the largest positive and negative surprises are listed. Go to www.zacks.com/research/earnings/today_eps.php and identify the top positive and the top negative earnings surprises for the day. The table will list the time and date of the announcement. Do you notice any difference between the times of day positive announcements tend to be made versus negative announcements?

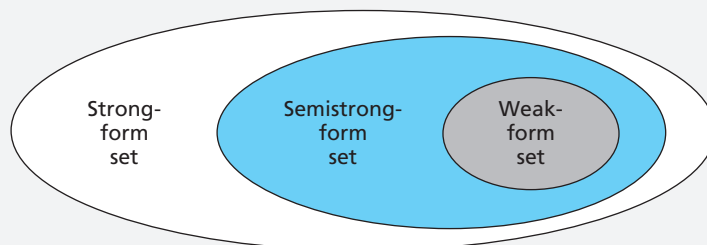
Identify the tickers for the top three positive surprises. Once you have identified the top surprises, go to **finance.yahoo.com**. Enter the ticker symbols and obtain quotes for these securities. Examine the 5-day charts for each of the companies. Is the information incorporated into price quickly? Is there any evidence of prior knowledge or anticipation of the disclosure in advance of the trading?

Choose one of the stocks listed and click on its symbol to follow the link for more information. Click on the link for Interactive Chart that appears under the graph. You can move the cursor over various parts of the graph to investigate what happened to the price and trading volume of the stock on each trading day. Do you notice any patterns?

E-INVEST- MENTS EXERCISES

SOLUTIONS TO CONCEPT CHECKS

1. a. A high-level manager might well have private information about the firm. Her ability to trade profitably on that information is not surprising. This ability does not violate weak-form efficiency: The abnormal profits are not derived from an analysis of past price and trading data. If they were, this would indicate that there is valuable information that can be gleaned from such analysis. But this ability does violate strong-form efficiency. Apparently, there is some private information that is not already reflected in stock prices.
- b. The information sets that pertain to the weak, semistrong, and strong form of the EMH can be described by the following illustration:



The weak-form information set includes only the history of prices and volumes. The semistrong-form set includes the weak form set *plus* all publicly available information. In turn, the strong-form set includes the semistrong set *plus* insiders' information. It is illegal

to act on this incremental information (insiders' private information). The direction of *valid* implication is

Strong-form EMH \Rightarrow Semistrong-form EMH \Rightarrow Weak-form EMH

The reverse direction implication is *not* valid. For example, stock prices may reflect all past price data (weak-form efficiency) but may not reflect relevant fundamental data (semistrong-form inefficiency).

2. The point made in the preceding discussion is that the very fact that we observe stock prices near so-called resistance levels belies the assumption that the price can be a resistance level. If a stock is observed to sell *at any price*, then investors must believe that a fair rate of return can be earned if the stock is purchased at that price. It is logically impossible for a stock to have a resistance level *and* offer a fair rate of return at prices just below the resistance level. If we accept that prices are appropriate, we must reject any presumption concerning resistance levels.
3. If *everyone* follows a passive strategy, sooner or later prices will fail to reflect new information. At this point there are profit opportunities for active investors who uncover mispriced securities. As they buy and sell these assets, prices again will be driven to fair levels.
4. Predictably declining CARs do violate the EMH. If one can predict such a phenomenon, a profit opportunity emerges: Sell (or short sell) the affected stocks on an event date just before their prices are predicted to fall.
5. The answer depends on your prior beliefs about market efficiency. Miller's record through 2005 was incredibly strong. On the other hand, with so many funds in existence, it is less surprising that *some* fund would appear to be consistently superior after the fact. Exceptional past performance of a small number of managers is possible by chance even in an efficient market. A better test is provided in "continuation studies." Are better performers in one period more likely to repeat that performance in later periods? Miller's record after 2005 fails the continuation or consistency criterion.

4. The various limits to arbitrage mean that even if prices do not equal intrinsic value, it still may be difficult to exploit the mispricing. As a result, the failure of traders to beat the market may not be proof that markets are in fact efficient, with prices equal to intrinsic value.
5. Technical analysis is the search for recurring and predictable patterns in stock prices. It is based on the premise that prices only gradually close in on intrinsic value. As fundamentals shift, astute traders can exploit the adjustment to a new equilibrium.
6. Technical analysis also uses volume data and sentiment indicators. These are broadly consistent with several behavioral models of investor activity.
7. The Dow theory attempts to identify underlying trends in stock indexes. Moving averages, relative strength, and breadth are used in other trend-based strategies.
8. Some sentiment indicators are the trin statistic, the confidence index, and the put/call ratio.

Related Web sites for this chapter are available at www.mhhe.com/bkm

behavioral finance
conservatism
representativeness
framing
mental accounting

regret avoidance
prospect theory
fundamental risk
disposition effect
Dow theory

breadth
trin statistic
confidence index
put/call ratio

KEY TERMS

1. Explain how some of the behavioral biases discussed in the chapter might contribute to the success of technical trading rules.
2. Why would an advocate of the efficient market hypothesis believe that even if many investors exhibit the behavioral biases discussed in the chapter, security prices might still be set efficiently?
3. What sorts of factors might limit the ability of rational investors to take advantage of any “pricing errors” that result from the actions of “behavioral investors”?
4. Even if behavioral biases do not affect equilibrium asset prices, why might it still be important for investors to be aware of them?
5. Some advocates of behavioral finance agree with efficient market advocates that indexing is the optimal investment strategy for most investors. But their reasons for this conclusion differ greatly. Compare and contrast the rationale for indexing according to both of these schools of thought.
6. Jill Davis tells her broker that she does not want to sell her stocks that are below the price she paid for them. She believes that if she just holds on to them a little longer they will recover, at which time she will sell them. What behavioral characteristic does Davis have as the basis for her decision making?
 - a. Loss aversion.
 - b. Conservatism.
 - c. Representativeness.
7. After Polly Shrum sells a stock, she avoids following it in the media. She is afraid that it may subsequently increase in price. What behavioral characteristic does Shrum have as the basis for her decision making?
 - a. Fear of regret.
 - b. Representativeness.
 - c. Mental accounting.
8. All of the following actions are consistent with feelings of regret *except*:
 - a. Selling losers quickly.
 - b. Hiring a full-service broker.
 - c. Holding on to losers too long.

PROBLEM SETS

i. Basic



9. Match each example to one of the following behavioral characteristics.

Example	Characteristic
a. Investors are slow to update their beliefs when given new evidence.	i. Disposition effect.
b. Investors are reluctant to bear losses caused by their unconventional decisions.	ii. Representativeness bias.
c. Investors exhibit less risk tolerance in their retirement accounts versus their other stock accounts.	iii. Regret avoidance.
d. Investors are reluctant to sell stocks with "paper" losses.	iv. Conservatism bias.
e. Investors disregard sample size when forming views about the future from the past.	v. Mental accounting.

10. What do we mean by fundamental risk, and why may such risk allow behavioral biases to persist for long periods of time?
11. What is meant by data mining, and why must technical analysts be careful not to engage in it?
12. Even if prices follow a random walk, they still may not be informationally efficient. Explain why this may be true, and why it matters for the efficient allocation of capital in our economy.
13. Use the data from *The Wall Street Journal* in Figure 12.7 to verify the trin ratio for the NYSE. Is the trin ratio bullish or bearish?
14. Calculate breadth for the NYSE using the data in Figure 12.7. Is the signal bullish or bearish?
15. Collect data on the DJIA for a period covering a few months. Try to identify primary trends. Can you tell whether the market currently is in an upward or downward trend?
16. Suppose Baa-rated bonds currently yield 6%, while Aa-rated bonds yield 5%. Suppose that due to an increase in the expected inflation rate, the yields on both bonds increase by 1%. What would happen to the confidence index? Would this be interpreted as bullish or bearish by a technical analyst? Does this make sense to you?
17. Table 12A presents price data for Computers, Inc., and a computer industry index. Does Computers, Inc., show relative strength over this period?
18. Use again the data in Table 12A to compute a 5-day moving average for Computers, Inc. Can you identify any buy or sell signals?
19. Yesterday, the Dow Jones industrials gained 54 points. However, 1,704 issues declined in price while 1,367 advanced. Why might a technical analyst be concerned even though the market index rose on this day?
20. Table 12B contains data on market advances and declines. Calculate cumulative breadth and decide whether this technical signal is bullish or bearish.
21. If the trading volume in advancing shares on day 1 in the previous problem was 330 million shares, while the volume in declining issues was 240 million shares, what was the trin statistic for that day? Was trin bullish or bearish?
22. Given the following data, is the confidence index rising or falling? What might explain the pattern of yield changes?

	This Year	Last Year
Yield on top-rated corporate bonds	8%	8.5%
Yield on intermediate-grade corporate bonds	10.5	10

ii. Intermediate

Trading Day	Computers, Inc.	Industry Index	Trading Day	Computers, Inc.	Industry Index
1	19.63	50.0	21	19.63	54.1
2	20	50.1	22	21.50	54.0
3	20.50	50.5	23	22	53.9
4	22	50.4	24	23.13	53.7
5	21.13	51.0	25	24	54.8
6	22	50.7	26	25.25	54.5
7	21.88	50.5	27	26.25	54.6
8	22.50	51.1	28	27	54.1
9	23.13	51.5	29	27.50	54.2
10	23.88	51.7	30	28	54.8
11	24.50	51.4	31	28.50	54.2
12	23.25	51.7	32	28	54.8
13	22.13	52.2	33	27.50	54.9
14	22	52.0	34	29	55.2
15	20.63	53.1	35	29.25	55.7
16	20.25	53.5	36	29.50	56.1
17	19.75	53.9	37	30	56.7
18	18.75	53.6	38	28.50	56.7
19	17.50	52.9	39	27.75	56.5
20	19	53.4	40	28	56.1

Table 12A

Computers, Inc., stock price history

Day	Advances	Declines	Day	Advances	Declines
1	906	704	6	970	702
2	653	986	7	1002	609
3	721	789	8	903	722
4	503	968	9	850	748
5	497	1095	10	766	766

Table 12B

Market advances and declines

23. Go to www.mhhe.com/bkm and link to the material for Chapter 12, where you will find 5 years of weekly returns for the S&P 500.
- Set up a spreadsheet to calculate the 26-week moving average of the index. Set the value of the index at the beginning of the sample period equal to 100. The index value in each week is then updated by multiplying the previous week's level by $(1 + \text{rate of return over previous week})$.
 - Identify every instance in which the index crosses through its moving average from below. In how many of the weeks following a cross-through does the index increase? Decrease?
 - Identify every instance in which the index crosses through its moving average from above. In how many of the weeks following a cross-through does the index increase? Decrease?
 - How well does the moving average rule perform in identifying buy or sell opportunities?

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24. Go to www.mhhe.com/bkm and link to the material for Chapter 12, where you will find 5 years of weekly returns for the S&P 500 and Fidelity's Select Banking Fund (ticker FSRBX).
- Set up a spreadsheet to calculate the relative strength of the banking sector compared to the broad market. Hint: As in the previous problem, set the initial value of the sector index and the S&P 500 index equal to 100, and use each week's rate of return to update the level of each index.
 - Identify every instance in which the relative strength ratio increases by at least 5% from its value 5 weeks earlier. In how many of the weeks following a substantial increase in relative strength does the banking sector outperform the S&P 500? In how many of those weeks does the banking sector underperform the S&P 500?
 - Identify every instance in which the relative strength ratio decreases by at least 5% from its value 5 weeks earlier. In how many of the weeks following a substantial decrease in relative strength does the banking sector underperform the S&P 500? In how many of those weeks does the banking sector outperform the S&P 500?
 - How well does the relative strength rule perform in identifying buy or sell opportunities?
25. One seeming violation of the Law of One Price is the pervasive discrepancy of closed-end fund prices from their net asset values. Would you expect to observe greater discrepancies on diversified or less-diversified funds? Why?

iii. Challenge



1. Don Sampson begins a meeting with his financial adviser by outlining his investment philosophy as shown below:

Statement Number	Statement
1	Investments should offer strong return potential but with very limited risk. I prefer to be conservative and to minimize losses, even if I miss out on substantial growth opportunities.
2	All nongovernmental investments should be in industry-leading and financially strong companies.
3	Income needs should be met entirely through interest income and cash dividends. All equity securities held should pay cash dividends.
4	Investment decisions should be based primarily on consensus forecasts of general economic conditions and company-specific growth.
5	If an investment falls below the purchase price, that security should be retained until it returns to its original cost. Conversely, I prefer to take quick profits on successful investments.
6	I will direct the purchase of investments, including derivative securities, periodically. These aggressive investments result from personal research and may not prove consistent with my investment policy. I have not kept records on the performance of similar past investments, but I have had some "big winners."

Select the statement from the table above that best illustrates each of the following behavioral finance concepts. Justify your selection.

- Mental accounting.
 - Overconfidence (illusion of control).
 - Reference dependence (framing).
2. Monty Frost's tax-deferred retirement account is invested entirely in equity securities. Because the international portion of his portfolio has performed poorly in the past, he has reduced his international equity exposure to 2%. Frost's investment adviser has recommended an increased international equity exposure. Frost responds with the following comments:

- a. On the basis of past poor performance, I want to sell all my remaining international equity securities once their market prices rise to equal their original cost.
- b. Most diversified international portfolios have had disappointing results over the past 5 years. During that time, however, the market in Country XYZ has outperformed all other markets, even our own. If I do increase my international equity exposure, I would prefer that the entire exposure consist of securities from Country XYZ.
- c. International investments are inherently more risky. Therefore, I prefer to purchase any international equity securities in my “speculative” account, my best chance at becoming rich. I do not want them in my retirement account, which has to protect me from poverty in my old age.

Frost’s adviser is familiar with behavioral finance concepts but prefers a traditional or standard finance approach (modern portfolio theory) to investments.

Indicate the behavioral finance concept that Frost most directly exhibits in each of his three comments. Explain how each of Frost’s comments can be countered by using an argument from standard finance.

3. Louise and Christopher Maclin live in London, United Kingdom, and currently rent an apartment in the metropolitan area. During an initial discussion of the Maclins’ financial plans, Christopher Maclin makes the following statements to the Maclins’ financial adviser, Grant Webb:
 - a. “I have used the Internet extensively to research the outlook for the housing market over the next 5 years, and I believe now is the best time to buy a house.”
 - b. “I do not want to sell any bond in my portfolio for a lower price than I paid for the bond.”
 - c. “I will not sell any of my company stock because I know my company and I believe it has excellent prospects for the future.”

For each statement (a)–(c) identify the behavioral finance concept most directly exhibited. Explain how each behavioral finance concept is affecting Maclin’s investment decision making.

4. During an interview with her investment adviser, a retired investor made the following two statements:
 - a. “I have been very pleased with the returns I’ve earned on Petrie stock over the past 2 years and I am certain that it will be a superior performer in the future.”
 - b. “I am pleased with the returns from the Petrie stock because I have specific uses for that money. For that reason, I certainly want my retirement fund to continue owning the Petrie stock.”

Identify which principle of behavioral finance is most consistent with each of the investor’s two statements.

5. Claire Pierce comments on her life circumstances and investment outlook:

I must support my parents who live overseas on Pogo Island. The Pogo Island economy has grown rapidly over the past 2 years with minimal inflation, and consensus forecasts call for a continuation of these favorable trends for the foreseeable future. Economic growth has resulted from the export of a natural resource used in an exciting new technology application.

I want to invest 10% of my portfolio in Pogo Island government bonds. I plan to purchase long-term bonds because my parents are likely to live more than 10 years. Experts uniformly do not foresee a resurgence of inflation on Pogo Island, so I am certain that the total returns produced by the bonds will cover my parents’ spending needs for many years to come. There should be no exchange rate risk because the bonds are denominated in local currency. I want to buy the Pogo Island bonds, but am not willing to distort my portfolio’s long-term asset allocation to do so. The overall mix of stocks, bonds, and other investments should not change. Therefore, I am considering selling one of my U.S. bond funds to raise cash to buy the Pogo Island bonds. One possibility is my

High Yield Bond Fund, which has declined 5% in value year to date. I am not excited about this fund's prospects; in fact I think it is likely to decline more, but there is a small probability that it could recover very quickly. So I have decided instead to sell my Core Bond Fund that has appreciated 5% this year. I expect this investment to continue to deliver attractive returns, but there is a small chance this year's gains might disappear quickly.

Once that shift is accomplished, my investments will be in great shape. The sole exception is my Small Company Fund, which has performed poorly. I plan to sell this investment as soon as the price increases to my original cost.

Identify three behavioral finance concepts illustrated in Pierce's comments and describe each of the three concepts. Discuss how an investor practicing standard or traditional finance would challenge each of the three concepts.

E-INVESTMENTS EXERCISES

Charting and Technical Analysis

Yahoo! Finance (finance.yahoo.com) offers significant capabilities in charting and other technical indicators. Under the charting function, you can specify comparisons between companies by choosing the technical analysis tab. Short interest ratios are found under the company profile report. Prepare charts of moving averages and obtain short interest ratios for GE and SWY. Prepare a 1-year chart of the 50- and 200-day average price of GE, SWY, and the S&P 500 index. Which, if either, of the companies is priced above its 50- and 200-day averages? Would you consider their charts as bullish or bearish? Why? What are the short interest ratios for the two companies? Has short interest displayed any significant trend?

SOLUTIONS TO CONCEPT CHECKS

1. Conservatism implies that investors will at first respond too slowly to new information, leading to trends in prices. Representativeness can lead them to extrapolate trends too far into the future and overshoot intrinsic value. Eventually, when the pricing error is corrected, we observe a reversal.
2. Out-of-favor stocks will exhibit low prices relative to various proxies for intrinsic value such as earnings. Because of regret avoidance, these stocks will need to offer a more attractive rate of return to induce investors to hold them. Thus, low P/E stocks might on average offer higher rates of return.
3. At liquidation, price will equal NAV. This puts a limit on fundamental risk. Investors need only carry the position for a few months to profit from the elimination of the discount. Moreover, as the liquidation date approaches, the discount should dissipate. This greatly limits the risk that the discount can move against the investor. At the announcement of impending liquidation, the discount should immediately disappear, or at least shrink considerably.
4. By the time the news of the recession affects bond yields, it also ought to affect stock prices. The market should fall *before* the confidence index signals that the time is ripe to sell.

premium bonds	investment-grade bonds	debenture
discount bonds	speculative-grade or junk	default premium
realized compound return	bonds	credit default swap (CDS)
horizon analysis	sinking fund	collateralized debt obligations
reinvestment rate risk	subordination clauses	(CDOs)
credit risk	collateral	

1. Define the following types of bonds:

- Catastrophe bond.
- Eurobond.
- Zero-coupon bond.
- Samurai bond.
- Junk bond.
- Convertible bond.
- Serial bond.
- Equipment obligation bond.
- Original issue discount bond.
- Indexed bond.
- Callable bond.
- Puttable bond.

2. Two bonds have identical times to maturity and coupon rates. One is callable at 105, the other at 110. Which should have the higher yield to maturity? Why?

3. The stated yield to maturity and realized compound yield to maturity of a (default-free) zero-coupon bond will always be equal. Why?

4. Why do bond prices go down when interest rates go up? Don't lenders like high interest rates?

5. A bond with an annual coupon rate of 4.8% sells for \$970. What is the bond's current yield?

6. Which security has a higher *effective* annual interest rate?

- A 3-month T-bill selling at \$97,645 with par value \$100,000.
- A coupon bond selling at par and paying a 10% coupon semiannually.

7. Treasury bonds paying an 8% coupon rate with *semiannual* payments currently sell at par value. What coupon rate would they have to pay in order to sell at par if they paid their coupons *annually*? (Hint: What is the effective annual yield on the bond?)

8. Consider a bond with a 10% coupon and with yield to maturity = 8%. If the bond's yield to maturity remains constant, then in 1 year, will the bond price be higher, lower, or unchanged? Why?

9. Consider an 8% coupon bond selling for \$953.10 with 3 years until maturity making *annual* coupon payments. The interest rates in the next 3 years will be, with certainty, $r_1 = 8%$, $r_2 = 10%$, and $r_3 = 12%$. Calculate the yield to maturity and realized compound yield of the bond.

10. Assume you have a 1-year investment horizon and are trying to choose among three bonds. All have the same degree of default risk and mature in 10 years. The first is a zero-coupon bond that pays \$1,000 at maturity. The second has an 8% coupon rate and pays the \$80 coupon once per year. The third has a 10% coupon rate and pays the \$100 coupon once per year.

- If all three bonds are now priced to yield 8% to maturity, what are their prices?
- If you expect their yields to maturity to be 8% at the beginning of next year, what will their prices be then? What is your before-tax holding-period return on each bond? If your tax bracket is 30% on ordinary income and 20% on capital gains income, what will your after-tax rate of return be on each?
- Recalculate your answer to (b) under the assumption that you expect the yields to maturity on each bond to be 7% at the beginning of next year.

PROBLEM SETS

i. Basic

ii. Intermediate

11. A 20-year maturity bond with par value of \$1,000 makes semiannual coupon payments at a coupon rate of 8%. Find the bond equivalent and effective annual yield to maturity of the bond if the bond price is:
 - a. \$950.
 - b. \$1,000.
 - c. \$1,050.
12. Repeat Problem 11 using the same data, but assuming that the bond makes its coupon payments annually. Why are the yields you compute lower in this case?
13. Fill in the table below for the following zero-coupon bonds, all of which have par values of \$1,000.

Price	Maturity (years)	Bond-Equivalent Yield to Maturity
\$400	20	—
\$500	20	—
\$500	10	—
—	10	10%
—	10	8%
\$400	—	8%

14. Consider a bond paying a coupon rate of 10% per year semiannually when the market interest rate is only 4% per half-year. The bond has 3 years until maturity.
 - a. Find the bond's price today and 6 months from now after the next coupon is paid.
 - b. What is the total (6-month) rate of return on the bond?
15. A bond with a coupon rate of 7% makes semiannual coupon payments on January 15 and July 15 of each year. *The Wall Street Journal* reports the asked price for the bond on January 30 at 100:02. What is the invoice price of the bond? The coupon period has 182 days.
16. A bond has a current yield of 9% and a yield to maturity of 10%. Is the bond selling above or below par value? Explain.
17. Is the coupon rate of the bond in Problem 16 more or less than 9%?
18. Return to Table 14.1 and calculate both the real and nominal rates of return on the TIPS bond in the second and third years.
19. A newly issued 20-year maturity, zero-coupon bond is issued with a yield to maturity of 8% and face value \$1,000. Find the imputed interest income in the first, second, and last year of the bond's life.
20. A newly issued 10-year maturity, 4% coupon bond making *annual* coupon payments is sold to the public at a price of \$800. What will be an investor's taxable income from the bond over the coming year? The bond will not be sold at the end of the year. The bond is treated as an original-issue discount bond.
21. A 30-year maturity, 8% coupon bond paying coupons semiannually is callable in 5 years at a call price of \$1,100. The bond currently sells at a yield to maturity of 7% (3.5% per half-year).
 - a. What is the yield to call?
 - b. What is the yield to call if the call price is only \$1,050?
 - c. What is the yield to call if the call price is \$1,100, but the bond can be called in 2 years instead of 5 years?
22. A 10-year bond of a firm in severe financial distress has a coupon rate of 14% and sells for \$900. The firm is currently renegotiating the debt, and it appears that the lenders will allow the firm to reduce coupon payments on the bond to one-half the originally contracted amount. The firm can handle these lower payments. What is the stated and expected yield to maturity of the bonds? The bond makes its coupon payments annually.
23. A 2-year bond with par value \$1,000 making annual coupon payments of \$100 is priced at \$1,000. What is the yield to maturity of the bond? What will be the realized compound yield to maturity if the 1-year interest rate next year turns out to be (a) 8%, (b) 10%, (c) 12%?

24. Suppose that today's date is April 15. A bond with a 10% coupon paid semiannually every January 15 and July 15 is listed in *The Wall Street Journal* as selling at an asked price of 101:04. If you buy the bond from a dealer today, what price will you pay for it?
25. Assume that two firms issue bonds with the following characteristics. Both bonds are issued at par.

	ABC Bonds	XYZ Bonds
Issue size	\$1.2 billion	\$150 million
Maturity	10 years*	20 years
Coupon	9%	10%
Collateral	First mortgage	General debenture
Callable	Not callable	In 10 years
Call price	None	110
Sinking fund	None	Starting in 5 years

*Bond is extendible at the discretion of the bondholder for an additional 10 years.

Ignoring credit quality, identify four features of these issues that might account for the lower coupon on the ABC debt. Explain.

26. An investor believes that a bond may temporarily increase in credit risk. Which of the following would be the most liquid method of exploiting this?
- The purchase of a credit default swap.
 - The sale of a credit default swap.
 - The short sale of the bond.
27. Which of the following *most accurately* describes the behavior of credit default swaps?
- When credit risk increases, swap premiums increase.
 - When credit and interest rate risk increases, swap premiums increase.
 - When credit risk increases, swap premiums increase, but when interest rate risk increases, swap premiums decrease.
28. What would be the likely effect on the yield to maturity of a bond resulting from:
- An increase in the issuing firm's times-interest-earned ratio.
 - An increase in the issuing firm's debt-to-equity ratio.
 - An increase in the issuing firm's quick ratio.
29. A large corporation issued both fixed and floating-rate notes 5 years ago, with terms given in the following table:

	9% Coupon Notes	Floating-Rate Note
Issue size	\$250 million	\$280 million
Original maturity	20 years	10 years
Current price (% of par)	93	98
Current coupon	9%	8%
Coupon adjusts	Fixed coupon	Every year
Coupon reset rule	—	1-year T-bill rate + 2%
Callable	10 years after issue	10 years after issue
Call price	106	102.50
Sinking fund	None	None
Yield to maturity	9.9%	—
Price range since issued	\$85–\$112	\$97–\$102

- Why is the price range greater for the 9% coupon bond than the floating-rate note?
- What factors could explain why the floating-rate note is not always sold at par value?
- Why is the call price for the floating-rate note not of great importance to investors?



- d. Is the probability of a call for the fixed-rate note high or low?
- e. If the firm were to issue a fixed-rate note with a 15-year maturity, what coupon rate would it need to offer to issue the bond at par value?
- f. Why is an entry for yield to maturity for the floating-rate note not appropriate?
30. Masters Corp. issues two bonds with 20-year maturities. Both bonds are callable at \$1,050. The first bond is issued at a deep discount with a coupon rate of 4% and a price of \$580 to yield 8.4%. The second bond is issued at par value with a coupon rate of 8 $\frac{3}{4}$ %.
- a. What is the yield to maturity of the par bond? Why is it higher than the yield of the discount bond?
- b. If you expect rates to fall substantially in the next 2 years, which bond would you prefer to hold?
- c. In what sense does the discount bond offer “implicit call protection”?
- iii. Challenge
31. A newly issued bond pays its coupons once annually. Its coupon rate is 5%, its maturity is 20 years, and its yield to maturity is 8%.
- a. Find the holding-period return for a 1-year investment period if the bond is selling at a yield to maturity of 7% by the end of the year.
- b. If you sell the bond after 1 year, what taxes will you owe if the tax rate on interest income is 40% and the tax rate on capital gains income is 30%? The bond is subject to original-issue discount tax treatment.
- c. What is the after-tax holding-period return on the bond?
- d. Find the realized compound yield *before taxes* for a 2-year holding period, assuming that (1) you sell the bond after 2 years, (2) the bond yield is 7% at the end of the second year, and (3) the coupon can be reinvested for 1 year at a 3% interest rate.
- e. Use the tax rates in (b) above to compute the *after-tax* 2-year realized compound yield. Remember to take account of OID tax rules.



1. Leaf Products may issue a 10-year maturity fixed-income security, which might include a sinking fund provision and either refunding or call protection.
- a. Describe a sinking fund provision.
- b. Explain the impact of a sinking fund provision on:
- The expected average life of the proposed security.
 - Total principal and interest payments over the life of the proposed security.
- c. From the investor’s point of view, explain the rationale for demanding a sinking fund provision.
2. Bonds of Zello Corporation with a par value of \$1,000 sell for \$960, mature in 5 years, and have a 7% annual coupon rate paid semiannually.
- a. Calculate the:
- Current yield.
 - Yield to maturity (to the nearest whole percent, i.e., 3%, 4%, 5%, etc.).
 - Realized compound yield for an investor with a 3-year holding period and a reinvestment rate of 6% over the period. At the end of 3 years the 7% coupon bonds with 2 years remaining will sell to yield 7%.
- b. Cite one major shortcoming for each of the following fixed-income yield measures:
- Current yield.
 - Yield to maturity.
 - Realized compound yield.
3. On May 30, 2008, Janice Kerr is considering one of the newly issued 10-year AAA corporate bonds shown in the following exhibit.

Description	Coupon	Price	Callable	Call Price
Sentinal, due May 30, 2018	6.00%	100	Noncallable	NA
Colina, due May 30, 2018	6.20%	100	Currently callable	102

- a. Suppose that market interest rates decline by 100 basis points (i.e., 1%). Contrast the effect of this decline on the price of each bond.
 - b. Should Kerr prefer the Colina over the Sentinel bond when rates are expected to rise or to fall?
 - c. What would be the effect, if any, of an increase in the *volatility* of interest rates on the prices of each bond?
4. A convertible bond has the following features:

Coupon	5.25%
Maturity	June 15, 2027
Market price of bond	\$77.50
Market price of underlying common stock	\$28.00
Annual dividend	\$1.20
Conversion ratio	20.83 shares

Calculate the conversion premium for this bond.

5.
 - a. Explain the impact on the offering yield of adding a call feature to a proposed bond issue.
 - b. Explain the impact on the bond's expected life of adding a call feature to a proposed bond issue.
 - c. Describe one advantage and one disadvantage of including callable bonds in a portfolio.
6.
 - a. An investment in a coupon bond will provide the investor with a return equal to the bond's yield to maturity at the time of purchase if:
 - i. The bond is not called for redemption at a price that exceeds its par value.
 - ii. All sinking fund payments are made in a prompt and timely fashion over the life of the issue.
 - iii. The reinvestment rate is the same as the bond's yield to maturity and the bond is held until maturity.
 - iv. All of the above.
 - b. A bond with a call feature:
 - i. Is attractive because the immediate receipt of principal plus premium produces a high return.
 - ii. Is more apt to be called when interest rates are high because the interest savings will be greater.
 - iii. Will usually have a higher yield to maturity than a similar noncallable bond.
 - iv. None of the above.
 - c. In which *one* of the following cases is the bond selling at a discount?
 - i. Coupon rate is greater than current yield, which is greater than yield to maturity.
 - ii. Coupon rate, current yield, and yield to maturity are all the same.
 - iii. Coupon rate is less than current yield, which is less than yield to maturity.
 - iv. Coupon rate is less than current yield, which is greater than yield to maturity.
 - d. Consider a 5-year bond with a 10% coupon that has a present yield to maturity of 8%. If interest rates remain constant, 1 year from now the price of this bond will be:
 - i. Higher.
 - ii. Lower.
 - iii. The same.
 - iv. Par.

Credit Spreads

At www.bondsonline.com review the *Industrial Spreads* for various ratings (click the links on the left-side menus to follow the links to *Today's Markets*, *Corporate Bond Spreads*). These are spreads above U.S. Treasuries of comparable maturities. What factors tend to explain the yield differences? How might these yield spreads differ during an economic boom versus a recession?

E-INVESTMENTS EXERCISES

From the home page, select *Today's Markets* from the left-side menu and then select the link for *Composite Bond Yields*. How do the Yield Curves for Treasury, Agency, Corporate, and Municipal bonds compare to each other?

SOLUTIONS TO CONCEPT CHECKS

1. The callable bond will sell at the *lower* price. Investors will not be willing to pay as much if they know that the firm retains a valuable option to reclaim the bond for the call price if interest rates fall.
2. At a semiannual interest rate of 3%, the bond is worth $\$40 \times \text{Annuity factor}(3\%, 60) + \$1,000 \times \text{PV factor}(3\%, 60) = \$1,276.76$, which results in a capital gain of \$276.76. This exceeds the capital loss of \$189.29 (i.e., $\$1,000 - \810.71) when the semiannual interest rate increased to 5%.
3. Yield to maturity exceeds current yield, which exceeds coupon rate. Take as an example the 8% coupon bond with a yield to maturity of 10% per year (5% per half year). Its price is \$810.71, and therefore its current yield is $80/810.71 = .0987$, or 9.87%, which is higher than the coupon rate but lower than the yield to maturity.
4. The bond with the 6% coupon rate currently sells for $30 \times \text{Annuity factor}(3.5\%, 20) + 1,000 \times \text{PV factor}(3.5\%, 20) = \928.94 . If the interest rate immediately drops to 6% (3% per half-year), the bond price will rise to \$1,000, for a capital gain of \$71.06, or 7.65%. The 8% coupon bond currently sells for \$1,071.06. If the interest rate falls to 6%, the present value of the *scheduled* payments increases to \$1,148.77. However, the bond will be called at \$1,100, for a capital gain of only \$28.94, or 2.70%.
5. The current price of the bond can be derived from its yield to maturity. Using your calculator, set: $n = 40$ (semiannual periods); payment = \$45 per period; future value = \$1,000; interest rate = 4% per semiannual period. Calculate present value as \$1,098.96. Now we can calculate yield to call. The time to call is 5 years, or 10 semiannual periods. The price at which the bond will be called is \$1,050. To find yield to call, we set: $n = 10$ (semiannual periods); payment = \$45 per period; future value = \$1,050; present value = \$1,098.96. Calculate yield to call as 3.72%.
6. Price = $\$70 \times \text{Annuity factor}(8\%, 1) + \$1,000 \times \text{PV factor}(8\%, 1) = \990.74

$$\text{Rate of return to investor} = \frac{\$70 + (\$990.74 - \$982.17)}{\$982.17} = .080 = 8\%$$

7. By year-end, remaining maturity is 29 years. If the yield to maturity were still 8%, the bond would still sell at par and the holding-period return would be 8%. At a higher yield, price and return will be lower. Suppose, for example, that the yield to maturity rises to 8.5%. With annual payments of \$80 and a face value of \$1,000, the price of the bond will be \$946.70 [$n = 29$; $i = 8.5\%$; $\text{PMT} = \$80$; $\text{FV} = \$1,000$]. The bond initially sold at \$1,000 when issued at the start of the year. The holding-period return is

$$\text{HPR} = \frac{80 + (946.70 - 1,000)}{1,000} = .0267 = 2.67\%$$

which is less than the initial yield to maturity of 8%.

8. At the lower yield, the bond price will be \$631.67 [$n = 29, i = 7\%, FV = \$1,000, PMT = \40]. Therefore, total after-tax income is

Coupon	$\$40 \times (1 - .38)$	= \$24.80
Imputed interest	$(\$553.66 - \$549.69) \times (1 - .38)$	= 2.46
Capital gains	$(\$631.67 - \$553.66) \times (1 - .20)$	= <u>62.41</u>
Total income after taxes		\$89.67
Rate of return = $89.67/549.69 = .163 = 16.3\%$.		

9. It should receive a negative coefficient. A high ratio of liabilities to assets is a poor omen for a firm that should lower its credit rating.
10. The coupon payment is \$45. There are 20 semiannual periods. The final payment is assumed to be \$500. The present value of expected cash flows is \$650. The expected yield to maturity is 6.317% semiannual or annualized, 12.63%, bond equivalent yield.

PROBLEM SETS

i. Basic



1. What is the relationship between forward rates and the market's expectation of future short rates? Explain in the context of both the expectations and liquidity preference theories of the term structure of interest rates.
2. Under the expectations hypothesis, if the yield curve is upward-sloping, the market must expect an increase in short-term interest rates. True/false/uncertain? Why?
3. Under the liquidity preference theory, if inflation is expected to be falling over the next few years, long-term interest rates will be higher than short-term rates. True/false/uncertain? Why?
4. If the liquidity preference hypothesis is true, what shape should the term structure curve have in a period where interest rates are expected to be constant?
 - a. Upward sloping.
 - b. Downward sloping.
 - c. Flat.
5. Which of the following is **true** according to the pure expectations theory? Forward rates:
 - a. Exclusively represent expected future short rates.
 - b. Are biased estimates of market expectations.
 - c. Always overestimate future short rates.
6. Assuming the pure expectations theory is correct, an upward-sloping yield curve implies:
 - a. Interest rates are expected to increase in the future.
 - b. Longer-term bonds are riskier than short-term bonds.
 - c. Interest rates are expected to decline in the future.
7. The following is a list of prices for zero-coupon bonds of various maturities. Calculate the yields to maturity of each bond and the implied sequence of forward rates.

Maturity (Years)	Price of Bond
1	\$943.40
2	898.47
3	847.62
4	792.16

8. Assuming that the expectations hypothesis is valid, compute the expected price path of the 4-year bond in the previous problem as time passes. What is the rate of return of the bond in each year? Show that the expected return equals the forward rate for each year.
9. Consider the following \$1,000 par value zero-coupon bonds:

Bond	Years to Maturity	YTM(%)
A	1	5%
B	2	6
C	3	6.5
D	4	7

According to the expectations hypothesis, what is the expected 1-year interest rate 3 years from now?

10. The term structure for zero-coupon bonds is currently:

Maturity (Years)	YTM (%)
1	4%
2	5
3	6

Next year at this time, *you* expect it to be:

Maturity (Years)	YTM (%)
1	5%
2	6
3	7

- a. What do *you* expect the rate of return to be over the coming year on a 3-year zero-coupon bond?
 - b. Under the expectations theory, what yields to maturity does *the market* expect to observe on 1- and 2-year zeros at the end of the year? Is the market's expectation of the return on the 3-year bond greater or less than yours?
11. The yield to maturity on 1-year zero-coupon bonds is currently 7%; the YTM on 2-year zeros is 8%. The Treasury plans to issue a 2-year maturity *coupon* bond, paying coupons once per year with a coupon rate of 9%. The face value of the bond is \$100.
- a. At what price will the bond sell?
 - b. What will the yield to maturity on the bond be?
 - c. If the expectations theory of the yield curve is correct, what is the market expectation of the price that the bond will sell for next year?
 - d. Recalculate your answer to (c) if you believe in the liquidity preference theory and you believe that the liquidity premium is 1%.
12. Below is a list of prices for zero-coupon bonds of various maturities.

Maturity (Years)	Price of \$1,000 Par Bond (Zero-Coupon)
1	\$943.40
2	873.52
3	816.37

- a. An 8.5% coupon \$1,000 par bond pays an annual coupon and will mature in 3 years. What should the yield to maturity on the bond be?
 - b. If at the end of the first year the yield curve flattens out at 8%, what will be the 1-year holding-period return on the coupon bond?
13. Prices of zero-coupon bonds reveal the following pattern of forward rates:

Year	Forward Rate
1	5%
2	7
3	8

In addition to the zero-coupon bond, investors also may purchase a 3-year bond making annual payments of \$60 with par value \$1,000.

- a. What is the price of the coupon bond?
 - b. What is the yield to maturity of the coupon bond?
 - c. Under the expectations hypothesis, what is the expected realized compound yield of the coupon bond?
 - d. If you forecast that the yield curve in 1 year will be flat at 7%, what is your forecast for the expected rate of return on the coupon bond for the 1-year holding period?
14. You observe the following term structure:

	Effective Annual YTM
1-year zero-coupon bond	6.1%
2-year zero-coupon bond	6.2
3-year zero-coupon bond	6.3
4-year zero-coupon bond	6.4

- a. If you believe that the term structure next year will be the same as today's, will the 1-year or the 4-year zeros provide a greater expected 1-year return?
- b. What if you believe in the expectations hypothesis?
15. The yield to maturity (YTM) on 1-year zero-coupon bonds is 5% and the YTM on 2-year zeros is 6%. The yield to maturity on 2-year-maturity coupon bonds with coupon rates of 12% (paid annually) is 5.8%. What arbitrage opportunity is available for an investment banking firm? What is the profit on the activity?
16. Suppose that a 1-year zero-coupon bond with face value \$100 currently sells at \$94.34, while a 2-year zero sells at \$84.99. You are considering the purchase of a 2-year-maturity bond making *annual* coupon payments. The face value of the bond is \$100, and the coupon rate is 12% per year.
- a. What is the yield to maturity of the 2-year zero? The 2-year coupon bond?
- b. What is the forward rate for the second year?
- c. If the expectations hypothesis is accepted, what are (1) the expected price of the coupon bond at the end of the first year and (2) the expected holding-period return on the coupon bond over the first year?
- d. Will the expected rate of return be higher or lower if you accept the liquidity preference hypothesis?

iii. Challenge

17. The current yield curve for default-free zero-coupon bonds is as follows:

Maturity (Years)	YTM (%)
1	10%
2	11
3	12

- a. What are the implied 1-year forward rates?
- b. Assume that the pure expectations hypothesis of the term structure is correct. If market expectations are accurate, what will be the pure yield curve (that is, the yields to maturity on 1- and 2-year zero coupon bonds) next year?
- c. If you purchase a 2-year zero-coupon bond now, what is the expected total rate of return over the next year? What if you purchase a 3-year zero-coupon bond? (*Hint*: Compute the current and expected future prices.) Ignore taxes.
- d. What should be the current price of a 3-year maturity bond with a 12% coupon rate paid annually? If you purchased it at that price, what would your total expected rate of return be over the next year (coupon plus price change)? Ignore taxes.
18. Suppose that the prices of zero-coupon bonds with various maturities are given in the following table. The face value of each bond is \$1,000.

Maturity (Years)	Price
1	\$925.93
2	853.39
3	782.92
4	715.00
5	650.00

- a. Calculate the forward rate of interest for each year.
- b. How could you construct a 1-year forward loan beginning in year 3? Confirm that the rate on that loan equals the forward rate.
- c. Repeat (b) for a 1-year forward loan beginning in year 4.
19. Continue to use the data in the preceding problem. Suppose that you want to construct a 2-year maturity forward loan commencing in 3 years.
- a. Suppose that you buy *today* one 3-year maturity zero-coupon bond. How many 5-year maturity zeros would you have to sell to make your initial cash flow equal to zero?
- b. What are the cash flows on this strategy in each year?

- c. What is the effective 2-year interest rate on the effective 3-year-ahead forward loan?
- d. Confirm that the effective 2-year interest rate equals $(1 + f_4) \times (1 + f_5) - 1$. You therefore can interpret the 2-year loan rate as a 2-year forward rate for the last 2 years. Alternatively, show that the effective 2-year forward rate equals

$$\frac{(1 + y_5)^5}{(1 + y_3)^3} - 1$$

- Briefly explain why bonds of different maturities have different yields in terms of the expectations and liquidity preference hypotheses. Briefly describe the implications of each hypothesis when the yield curve is (1) upward-sloping and (2) downward-sloping.
- Which one of the following statements about the term structure of interest rates is true?
 - The expectations hypothesis indicates a flat yield curve if anticipated future short-term rates exceed current short-term rates.
 - The expectations hypothesis contends that the long-term rate is equal to the anticipated short-term rate.
 - The liquidity premium theory indicates that, all else being equal, longer maturities will have lower yields.
 - The liquidity preference theory contends that lenders prefer to buy securities at the short end of the yield curve.
- The following table shows yields to maturity of zero-coupon Treasury securities.



Term to Maturity (Years)	Yield to Maturity (%)
1	3.50%
2	4.50
3	5.00
4	5.50
5	6.00
10	6.60

- Calculate the forward 1-year rate of interest for year 3.
 - Describe the conditions under which the calculated forward rate would be an unbiased estimate of the 1-year spot rate of interest for that year.
 - Assume that a few months earlier, the forward 1-year rate of interest for that year had been significantly higher than it is now. What factors could account for the decline in the forward rate?
- The 6-month Treasury bill spot rate is 4%, and the 1-year Treasury bill spot rate is 5%. What is the implied 6-month forward rate for 6 months from now?
 - The tables below show, respectively, the characteristics of two annual-pay bonds from the same issuer with the same priority in the event of default, and spot interest rates. Neither bond's price is consistent with the spot rates. Using the information in these tables, recommend either bond *A* or bond *B* for purchase.

Bond Characteristics

	Bond A	Bond B
Coupons	Annual	Annual
Maturity	3 years	3 years
Coupon rate	10%	6%
Yield to maturity	10.65%	10.75%
Price	98.40	88.34

Spot Interest Rates

Term (Years)	Spot Rates (Zero-Coupon)
1	5%
2	8
3	11

6. Sandra Kapple is a fixed-income portfolio manager who works with large institutional clients. Kapple is meeting with Maria VanHusen, consultant to the Star Hospital Pension Plan, to discuss management of the fund's approximately \$100 million Treasury bond portfolio. The current U.S. Treasury yield curve is given in the following table. VanHusen states, "Given the large differential between 2- and 10-year yields, the portfolio would be expected to experience a higher return over a 10-year horizon by buying 10-year Treasuries, rather than buying 2-year Treasuries and reinvesting the proceeds into 2-year T-bonds at each maturity date."

Maturity	Yield	Maturity	Yield
1 year	2.00%	6 years	4.15%
2	2.90	7	4.30
3	3.50	8	4.45
4	3.80	9	4.60
5	4.00	10	4.70

- a. Indicate whether VanHusen's conclusion is correct, based on the pure expectations hypothesis.
- b. VanHusen discusses with Kapple alternative theories of the term structure of interest rates and gives her the following information about the U.S. Treasury market:

Maturity (years)	2	3	4	5	6	7	8	9	10
Liquidity premium (%)	.55	.55	.65	.75	.90	1.10	1.20	1.50	1.60

Use this additional information and the liquidity preference theory to determine what the slope of the yield curve implies about the direction of future expected short-term interest rates.

7. A portfolio manager at Superior Trust Company is structuring a fixed-income portfolio to meet the objectives of a client. The portfolio manager compares coupon U.S. Treasuries with zero-coupon stripped U.S. Treasuries and observes a significant yield advantage for the stripped bonds:

Term	Coupon U.S. Treasuries	Zero-Coupon Stripped U.S. Treasuries
3 years	5.50%	5.80%
7	6.75	7.25
10	7.25	7.60
30	7.75	8.20

Briefly discuss why zero-coupon stripped U.S. Treasuries could yield more than coupon U.S. Treasuries with the same final maturity.

8. The shape of the U.S. Treasury yield curve appears to reflect two expected Federal Reserve reductions in the federal funds rate. The current short-term interest rate is 5%. The first reduction of approximately 50 basis points (bp) is expected 6 months from now and the second reduction of approximately 50 bp is expected 1 year from now. The current U.S. Treasury term premiums are 10 bp per year for each of the next 3 years (out through the 3-year benchmark).

However, the market also believes that the Federal Reserve reductions will be reversed in a single 100-bp increase in the federal funds rate 2½ years from now. You expect liquidity premiums to remain 10 bp per year for each of the next 3 years (out through the 3-year benchmark).

Describe or draw the shape of the Treasury yield curve out through the 3-year benchmark. Which term structure theory supports the shape of the U.S. Treasury yield curve you've described?

9. U.S. Treasuries represent a significant holding in many pension portfolios. You decide to analyze the yield curve for U.S. Treasury notes.
- Using the data in the table below, calculate the 5-year spot and forward rates assuming annual compounding. Show your calculations.

U.S. Treasury Note Yield Curve Data

Years to Maturity	Par Coupon Yield to Maturity	Calculated Spot Rates	Calculated Forward Rates
1	5.00	5.00	5.00
2	5.20	5.21	5.42
3	6.00	6.05	7.75
4	7.00	7.16	10.56
5	7.00	?	?

- Define and describe each of the following three concepts:
 - Short rate
 - Spot rate
 - Forward rate
 Explain how these concepts are related.
 - You are considering the purchase of a zero-coupon U.S. Treasury note with 4 years to maturity. On the basis of the above yield-curve analysis, calculate both the expected yield to maturity and the price for the security. Show your calculations.
10. The spot rates of interest for five U.S. Treasury Securities are shown in the following exhibit. Assume all securities pay interest annually.

Spot Rates of Interest

Term to Maturity	Spot Rate of Interest
1 year	13.00%
2	12.00
3	11.00
4	10.00
5	9.00

- Compute the 2-year implied forward rate for a deferred loan beginning in 3 years.
- Compute the price of a 5-year annual-pay Treasury security with a coupon rate of 9% by using the information in the exhibit.

The Yield Curve

Go to www.smartmoney.com. Access the *Living Yield Curve* (look for the *Economy and Bonds* tab), a moving picture of the yield curve. Is the yield curve usually upward- or downward-sloping? What about today's yield curve? How much does the slope of the curve vary? Which varies more: short-term or long-term rates? Can you explain why this might be the case?

E-INVESTMENTS EXERCISES

SOLUTIONS TO CONCEPT CHECKS

1. The price of the 3-year bond paying a \$40 coupon is

$$\frac{40}{1.05} + \frac{40}{1.06^2} + \frac{1040}{1.07^3} = 38.095 + 35.600 + 848.950 = \$922.65$$

At this price, the yield to maturity is 6.945% [$n = 3$; $PV = (-)922.65$; $FV = 1,000$; $PMT = 40$]. This bond's yield to maturity is closer to that of the 3-year zero-coupon bond than is the yield to maturity of the 10% coupon bond in Example 15.1. This makes sense: this bond's coupon rate is lower than that of the bond in Example 15.1. A greater fraction of its value is tied up in the final payment in the third year, and so it is not surprising that its yield is closer to that of a pure 3-year zero-coupon security.

2. We compare two investment strategies in a manner similar to Example 15.2:

Buy and hold 4-year zero = Buy 3-year zero; roll proceeds into 1-year bond

$$(1 + y_4)^4 = (1 + y_3)^3 \times (1 + r_4)$$

$$1.08^4 = 1.07^3 \times (1 + r_4)$$

which implies that $r_4 = 1.08^4/1.07^3 - 1 = .11056 = 11.056\%$. Now we confirm that the yield on the 4-year zero is a geometric average of the discount factors for the next 3 years:

$$1 + y_4 = [(1 + r_1) \times (1 + r_2) \times (1 + r_3) \times (1 + r_4)]^{1/4}$$

$$1.08 = [1.05 \times 1.0701 \times 1.09025 \times 1.11056]^{1/4}$$

3. The 3-year bond can be bought today for $\$1,000/1.07^3 = \816.30 . Next year, it will have a remaining maturity of 2 years. The short rate in year 2 will be 7.01% and the short rate in year 3 will be 9.025%. Therefore, the bond's yield to maturity next year will be related to these short rates according to

$$(1 + y_2)^2 = 1.0701 \times 1.09025 = 1.1667$$

and its price next year will be $\$1,000/(1 + y_2)^2 = \$1,000/1.1667 = \$857.12$. The 1-year holding-period rate of return is therefore $(\$857.12 - \$816.30)/\$816.30 = .05$, or 5%.

4. The n -period *spot* rate is the yield to maturity on a zero-coupon bond with a maturity of n periods. The *short* rate for period n is the *one-period* interest rate that will prevail in period n . Finally, the *forward* rate for period n is the short rate that would satisfy a "break-even condition" equating the total returns on two n -period investment strategies. The first strategy is an investment in an n -period zero-coupon bond; the second is an investment in an $n - 1$ period zero-coupon bond "rolled over" into an investment in a one-period zero. Spot rates and forward rates are observable today, but because interest rates evolve with uncertainty, future short rates are not. *In the special case* in which there is no uncertainty in future interest rates, the forward rate calculated from the yield curve would equal the short rate that will prevail in that period.
5. $7\% - 1\% = 6\%$.
6. The risk premium will be zero.
7. If issuers prefer to issue long-term bonds, they will be willing to accept higher expected interest costs on long bonds over short bonds. This willingness combines with investors' demands for higher rates on long-term bonds to reinforce the tendency toward a positive liquidity premium.
8. In general, from Equation 15.5, $(1 + y_n)^n = (1 + y_{n-1})^{n-1} \times (1 + f_n)$. In this case, $(1 + y_4)^4 = (1.07)^3 \times (1 + f_4)$. If $f_4 = .07$, then $(1 + y_4)^4 = (1.07)^4$ and $y_4 = .07$. If f_4 is greater than .07, then y_4 also will be greater, and conversely if f_4 is less than .07, then y_4 will be as well.

9. The 3-year yield to maturity is $\left(\frac{1,000}{816.30}\right)^{1/3} - 1 = .07 = 7.0\%$

The forward rate for the third year is therefore

$$f_3 = \frac{(1 + y_3)^3}{(1 + y_2)^2} - 1 = \frac{1.07^3}{1.06^2} - 1 = .0903 = 9.03\%$$

(Alternatively, note that the ratio of the price of the 2-year zero to the price of the 3-year zero is $1 + f_3 = 1.0903$.) To construct the synthetic loan, buy one 2-year maturity zero, and sell 1.0903 3-year maturity zeros. Your initial cash flow is zero, your cash flow at time 2 is +\$1,000, and your cash flow at time 3 is -\$1,090.30, which corresponds to the cash flows on a 1-year forward loan commencing at time 2 with an interest rate of 9.03%.

SUMMARY

1. Even default-free bonds such as Treasury issues are subject to interest rate risk. Longer-term bonds generally are more sensitive to interest rate shifts than are short-term bonds. A measure of the average life of a bond is Macaulay's duration, defined as the weighted average of the times until each payment made by the security, with weights proportional to the present value of the payment.
2. Duration is a direct measure of the sensitivity of a bond's price to a change in its yield. The proportional change in a bond's price equals the negative of duration multiplied by the proportional change in $1 + y$.
3. Convexity refers to the curvature of a bond's price-yield relationship. Accounting for convexity can substantially improve on the accuracy of the duration approximation for the response of bond price to changes in yield.
4. Immunization strategies are characteristic of passive fixed-income portfolio management. Such strategies attempt to render the individual or firm immune from movements in interest rates. This may take the form of immunizing net worth or, instead, immunizing the future accumulated value of a fixed-income portfolio.
5. Immunization of a fully funded plan is accomplished by matching the durations of assets and liabilities. To maintain an immunized position as time passes and interest rates change, the portfolio must be periodically rebalanced. Classic immunization also depends on parallel shifts in a flat yield curve. Given that this assumption is unrealistic, immunization generally will be less than complete. To mitigate the problem, multifactor duration models can be used to allow for variation in the shape of the yield curve.
6. A more direct form of immunization is dedication, or cash flow matching. If a portfolio is perfectly matched in cash flow with projected liabilities, rebalancing will be unnecessary.
7. Active bond management consists of interest rate forecasting techniques and intermarket spread analysis. One popular taxonomy classifies active strategies as substitution swaps, intermarket spread swaps, rate anticipation swaps, or pure yield pickup swaps.
8. Horizon analysis is a type of interest rate forecasting. In this procedure the analyst forecasts the position of the yield curve at the end of some holding period, and from that yield curve predicts corresponding bond prices. Bonds then can be ranked according to expected total returns (coupon plus capital gain) over the holding period.

Related Web sites for this chapter are available at www.mhhe.com/bkm

KEY TERMS

Macaulay's duration	rebalancing	rate anticipation swap
modified duration	cash flow matching	pure yield pickup swap
convexity	dedication strategy	tax swap
effective duration	substitution swap	horizon analysis
immunization	intermarket spread swap	

PROBLEM SETS

i. Basic

ii. Intermediate

1. Prices of long-term bonds are more volatile than prices of short-term bonds. However, yields to maturity of short-term bonds fluctuate more than yields of long-term bonds. How do you reconcile these two empirical observations?
2. How can a perpetuity, which has an infinite maturity, have a duration as short as 10 or 20 years?
3. A 9-year bond has a yield of 10% and a duration of 7.194 years. If the market yield changes by 50 basis points, what is the percentage change in the bond's price?
4. Find the duration of a 6% coupon bond making *annual* coupon payments if it has 3 years until maturity and has a yield to maturity of 6%. What is the duration if the yield to maturity is 10%?
5. Find the duration of the bond in Problem 4 if the coupons are paid semiannually.

6. The historical yield spread between AAA bonds and Treasury bonds widened dramatically in 2008. If you believe the spread will soon return to more typical historical levels, what should you do? This would be an example of what sort of bond swap?
7. You predict that interest rates are about to fall. Which bond will give you the highest capital gain?
 - a. Low coupon, long maturity.
 - b. High coupon, short maturity.
 - c. High coupon, long maturity.
 - d. Zero coupon, long maturity.
8. Rank the durations or effective durations of the following pairs of bonds:
 - a. Bond A is an 8% coupon bond, with a 20-year time to maturity selling at par value. Bond B is an 8% coupon bond, with a 20-year maturity time selling below par value.
 - b. Bond A is a 20-year noncallable coupon bond with a coupon rate of 8%, selling at par. Bond B is a 20-year callable bond with a coupon rate of 9%, also selling at par.
9. An insurance company must make payments to a customer of \$10 million in 1 year and \$4 million in 5 years. The yield curve is flat at 10%.
 - a. If it wants to fully fund and immunize its obligation to this customer with a *single* issue of a zero-coupon bond, what maturity bond must it purchase?
 - b. What must be the face value and market value of that zero-coupon bond?
10. Long-term Treasury bonds currently are selling at yields to maturity of nearly 8%. You expect interest rates to fall. The rest of the market thinks that they will remain unchanged over the coming year. In each question, choose the bond that will provide the higher holding-period return over the next year if you are correct. Briefly explain your answer.
 - a.
 - i. A Baa-rated bond with coupon rate 8% and time to maturity 20 years.
 - ii. An Aaa-rated bond with coupon rate of 8% and time to maturity 20 years.
 - b.
 - i. An A-rated bond with coupon rate 4% and maturity 20 years, callable at 105.
 - ii. An A-rated bond with coupon rate 8% and maturity 20 years, callable at 105.
 - c.
 - i. A 6% coupon noncallable T-bond with maturity 20 years and YTM = 8%.
 - ii. A 9% coupon noncallable T-bond with maturity 20 years and YTM = 8%.
11. Currently, the term structure is as follows: 1-year bonds yield 7%, 2-year bonds yield 8%, 3-year bonds and longer-maturity bonds all yield 9%. An investor is choosing between 1-, 2-, and 3-year maturity bonds all paying annual coupons of 8%, once a year. Which bond should you buy if you strongly believe that at year-end the yield curve will be flat at 9%?
12. You will be paying \$10,000 a year in tuition expenses at the end of the next 2 years. Bonds currently yield 8%.
 - a. What is the present value and duration of your obligation?
 - b. What maturity zero-coupon bond would immunize your obligation?
 - c. Suppose you buy a zero-coupon bond with value and duration equal to your obligation. Now suppose that rates immediately increase to 9%. What happens to your net position, that is, to the difference between the value of the bond and that of your tuition obligation? What if rates fall to 7%?
13. Pension funds pay lifetime annuities to recipients. If a firm will remain in business indefinitely, the pension obligation will resemble a perpetuity. Suppose, therefore, that you are managing a pension fund with obligations to make perpetual payments of \$2 million per year to beneficiaries. The yield to maturity on all bonds is 16%.
 - a. If the duration of 5-year maturity bonds with coupon rates of 12% (paid annually) is 4 years and the duration of 20-year maturity bonds with coupon rates of 6% (paid annually) is 11 years, how much of each of these coupon bonds (in market value) will you want to hold to both fully fund and immunize your obligation?
 - b. What will be the par value of your holdings in the 20-year coupon bond?

14. You are managing a portfolio of \$1 million. Your target duration is 10 years, and you can choose from two bonds: a zero-coupon bond with maturity of 5 years, and a perpetuity, each currently yielding 5%.
- How much of each bond will you hold in your portfolio?
 - How will these fractions change *next year* if target duration is now 9 years?
15. My pension plan will pay me \$10,000 once a year for a 10-year period. The first payment will come in exactly 5 years. The pension fund wants to immunize its position.
- What is the duration of its obligation to me? The current interest rate is 10% per year.
 - If the plan uses 5-year and 20-year zero-coupon bonds to construct the immunized position, how much money ought to be placed in each bond? What will be the *face value* of the holdings in each zero?
16. A 30-year maturity bond making annual coupon payments with a coupon rate of 12% has duration of 11.54 years and convexity of 192.4. The bond currently sells at a yield to maturity of 8%. Use a financial calculator or spreadsheet to find the price of the bond if its yield to maturity falls to 7% or rises to 9%. What prices for the bond at these new yields would be predicted by the duration rule and the duration-with-convexity rule? What is the percentage error for each rule? What do you conclude about the accuracy of the two rules?
17. Frank Meyers, CFA, is a fixed-income portfolio manager for a large pension fund. A member of the Investment Committee, Fred Spice, is very interested in learning about the management of fixed-income portfolios. Spice has approached Meyers with several questions. Specifically, Spice would like to know how fixed-income managers position portfolios to capitalize on their expectations of future interest rates.

Meyers decides to illustrate fixed-income trading strategies to Spice using a fixed-rate bond and note. Both bonds have semiannual coupon periods. Unless otherwise stated all interest rate changes are parallel. The characteristics of these securities are shown in the following table. He also considers a 9-year floating-rate bond (floater) that pays a floating rate semiannually and is currently yielding 5%.

Characteristics of Fixed-Rate Bond and Fixed-Rate Note

	Fixed-Rate Bond	Fixed-Rate Note
Price	107.18	100.00
Yield to maturity	5.00%	5.00%
Period to maturity	18	8
Modified duration	6.9848	3.5851

Spice asks Meyers about how a fixed-income manager would position his portfolio to capitalize on expectations of increasing interest rates. Which of the following would be the most appropriate strategy?

- Shorten his portfolio duration.
 - Buy fixed-rate bonds.
 - Lengthen his portfolio duration.
18. Spice asks Meyers (see previous problem) to quantify price changes from changes in interest rates. To illustrate, Meyers computes the value change for the fixed-rate note in the table. Specifically, he assumes an increase in the level of interest rate of 100 basis points. Using the information in the table, what is the predicted change in the price of the fixed-rate note?
19. A 30-year maturity bond has a 7% coupon rate, paid annually. It sells today for \$867.42. A 20-year maturity bond has 6.5% coupon rate, also paid annually. It sells today for \$879.50. A bond market analyst forecasts that in 5 years, 25-year maturity bonds will sell at yields to maturity of 8% and 15-year maturity bonds will sell at yields of 7.5%. Because the yield curve is upward sloping, the analyst believes that coupons will be invested in short-term securities at a rate of 6%. Which bond offers the higher expected rate of return over the 5-year period?



20. *a.* Use a spreadsheet to calculate the durations of the two bonds in Spreadsheet 16.1 if the annual interest rate increases to 12%. Why does the duration of the coupon bond fall while that of the zero remains unchanged? (*Hint:* Examine what happens to the weights computed in column F.)
- b.* Use the same spreadsheet to calculate the duration of the coupon bond if the coupon were 12% instead of 8% and the semiannual interest rate is again 5%. Explain why duration is lower than in Spreadsheet 16.1. (Again, start by looking at column F.)
21. *a.* Footnote 6 presents the formula for the convexity of a bond. Build a spreadsheet to calculate the convexity of a 5-year, 8% coupon bond making annual payments at the initial yield to maturity of 10%.
- b.* What is the convexity of a 5-year zero-coupon bond?
22. A 12.75-year maturity zero-coupon bond selling at a yield to maturity of 8% (effective annual yield) has convexity of 150.3 and modified duration of 11.81 years. A 30-year maturity 6% coupon bond making annual coupon payments also selling at a yield to maturity of 8% has nearly identical duration—11.79 years—but considerably higher convexity of 231.2.
 - a.* Suppose the yield to maturity on both bonds increases to 9%. What will be the actual percentage capital loss on each bond? What percentage capital loss would be predicted by the duration-with-convexity rule?
 - b.* Repeat part (*a*), but this time assume the yield to maturity decreases to 7%.
 - c.* Compare the performance of the two bonds in the two scenarios, one involving an increase in rates, the other a decrease. Based on the comparative investment performance, explain the attraction of convexity.
 - d.* In view of your answer to (*c*), do you think it would be possible for two bonds with equal duration but different convexity to be priced initially at the same yield to maturity if the yields on both bonds always increased or decreased by equal amounts, as in this example? Would anyone be willing to buy the bond with lower convexity under these circumstances?
23. A newly issued bond has a maturity of 10 years and pays a 7% coupon rate (with coupon payments coming once annually). The bond sells at par value.
 - a.* What are the convexity and the duration of the bond? Use the formula for convexity in footnote 6.
 - b.* Find the actual price of the bond assuming that its yield to maturity immediately increases from 7% to 8% (with maturity still 10 years).
 - c.* What price would be predicted by the duration rule (Equation 16.3)? What is the percentage error of that rule?
 - d.* What price would be predicted by the duration-with-convexity rule (Equation 16.5)? What is the percentage error of that rule?

iii. Challenge

1. *a.* Explain the impact on the offering yield of adding a call feature to a proposed bond issue.
- b.* Explain the impact on *both* effective bond duration and convexity of adding a call feature to a proposed bond issue.
2. *a.* A 6% coupon bond paying interest annually has a modified duration of 10 years, sells for \$800, and is priced at a yield to maturity of 8%. If the YTM increases to 9%, what is the predicted change in price using the duration concept?
- b.* A 6% coupon bond with semiannual coupons has a convexity (in years) of 120, sells for 80% of par, and is priced at a yield to maturity of 8%. If the YTM increases to 9.5%, what is the predicted contribution to the percentage change in price due to convexity?
- c.* A bond with annual coupon payments has a coupon rate of 8%, yield to maturity of 10%, and Macaulay duration of 9 years. What is the bond's modified duration?
- d.* When interest rates decline, the duration of a 30-year bond selling at a premium:
 - i. Increases.
 - ii. Decreases.
 - iii. Remains the same.
 - iv. Increases at first, then declines.



- e. If a bond manager swaps a bond for one that is identical in terms of coupon rate, maturity, and credit quality but offers a higher yield to maturity, the swap is:
 - i. A substitution swap.
 - ii. An interest rate anticipation swap.
 - iii. A tax swap.
 - iv. An intermarket spread swap.
 - f. Which bond has the longest duration?
 - i. 8-year maturity, 6% coupon.
 - ii. 8-year maturity, 11% coupon.
 - iii. 15-year maturity, 6% coupon.
 - iv. 15-year maturity, 11% coupon.
3. A newly issued bond has the following characteristics:

Coupon	Yield to Maturity	Maturity	Macaulay Duration
8%	8%	15 years	10 years

- a. Calculate modified duration using the information above.
 - b. Explain why modified duration is a better measure than maturity when calculating the bond's sensitivity to changes in interest rates.
 - c. Identify the direction of change in modified duration if:
 - i. The coupon of the bond were 4%, not 8%.
 - ii. The maturity of the bond were 7 years, not 15 years.
 - d. Define convexity and explain how modified duration and convexity are used to approximate the bond's percentage change in price, given a change in interest rates.
4. Bonds of Zello Corporation with a par value of \$1,000 sell for \$960, mature in 5 years, and have a 7% annual coupon rate paid semiannually.
- a. Calculate each of the following yields:
 - i. Current yield.
 - ii. Yield to maturity (to the nearest whole percent, i.e., 3%, 4%, 5%, etc.).
 - iii. Horizon yield (also called total compound return) for an investor with a 3-year holding period and a reinvestment rate of 6% over the period. At the end of 3 years the 7% coupon bonds with 2 years remaining will sell to yield 7%.
 - b. Cite a major shortcoming for each of the following fixed-income yield measures:
 - i. Current yield.
 - ii. Yield to maturity.
 - iii. Horizon yield (also called total compound return).
5. Sandra Kapple presents Maria VanHusen with a description, given in the following table, of the bond portfolio held by the Star Hospital Pension Plan. All securities in the bond portfolio are noncallable U.S. Treasury securities.

Par Value (U.S. \$)	Treasury Security	Market Value (U.S. \$)	Current Price	Price If Yields Change		Effective Duration
				Up 100 Basis Points	Down 100 Basis Points	
48,000,000	2.375% due 2011	48,667,680	101.391	99.245	103.595	2.15
50,000,000	4.75% due 2036	50,000,000	100.000	86.372	116.887	—
98,000,000	Total Bond Portfolio	98,667,680	—	—	—	—

- a. Calculate the effective duration of each of the following:
 - i. The 4.75% Treasury security due 2036.
 - ii. The total bond portfolio.

- b. VanHusen remarks to Kapple, “If you changed the maturity structure of the bond portfolio to result in a portfolio duration of 5.25, the price sensitivity of that portfolio would be identical to the price sensitivity of a single, noncallable Treasury security that has a duration of 5.25.” In what circumstance would VanHusen’s remark be correct?
6. One common goal among fixed-income portfolio managers is to earn high incremental returns on corporate bonds versus government bonds of comparable durations. The approach of some corporate-bond portfolio managers is to find and purchase those corporate bonds having the largest initial spreads over comparable-duration government bonds. John Ames, HFS’s fixed-income manager, believes that a more rigorous approach is required if incremental returns are to be maximized.

The following table presents data relating to one set of corporate/government spread relationships present in the market at a given date:

Bond Rating	Initial Spread over Governments	Expected Horizon Spread	Initial Duration	Expected Duration 1 Year from Now
Aaa	31 b.p.	31 b.p.	4 years	3.1 years
Aa	40 b.p.	50 b.p.	4 years	3.1 years

Note: 1 b.p. means 1 basis point, or .01%.

- a. Recommend purchase of either Aaa or Aa bonds for a 1-year investment horizon given a goal of maximizing incremental returns.
- b. Ames chooses not to rely *solely* on initial spread relationships. His analytical framework considers a full range of other key variables likely to impact realized incremental returns, including call provisions and potential changes in interest rates. Describe variables, in addition to those identified above, that Ames should include in his analysis and explain how each of these could cause realized incremental returns to differ from those indicated by initial spread relationships.
7. Patrick Wall is considering the purchase of one of the two bonds described in the following table. Wall realizes his decision will depend primarily on effective duration, and he believes that interest rates will decline by 50 basis points at all maturities over the next 6 months.

Characteristic	CIC	PTR
Market price	101.75	101.75
Maturity date	June 1, 2022	June 1, 2022
Call date	Noncallable	June 1, 2017
Annual coupon	5.25%	6.35%
Interest payment	Semiannual	Semiannual
Effective duration	7.35	5.40
Yield to maturity	5.02%	6.10%
Credit rating	A	A

- a. Calculate the percentage price change forecasted by effective duration for both the CIC and PTR bonds if interest rates decline by 50 basis points over the next 6 months.
- b. Calculate the 6-month horizon return (in percent) for each bond, if the actual CIC bond price equals 105.55 and the actual PTR bond price equals 104.15 at the end of 6 months.
- c. Wall is surprised by the fact that although interest rates fell by 50 basis points, the actual price change for the CIC bond was greater than the price change forecasted by effective duration, whereas the actual price change for the PTR bond was less than the price change forecasted by effective duration. Explain why the actual price change would be greater for the CIC bond and the actual price change would be less for the PTR bond.

8. You are the manager for the bond portfolio of a pension fund. The policies of the fund allow for the use of active strategies in managing the bond portfolio.

It appears that the economic cycle is beginning to mature, inflation is expected to accelerate, and in an effort to contain the economic expansion, central bank policy is moving toward constraint. For each of the situations below, state which one of the two bonds you would prefer. Briefly justify your answer in each case.

- a. Government of Canada (Canadian pay) 4% due in 2014 and priced at 98.75 to yield 4.50% to maturity.

or

Government of Canada (Canadian pay) 4% due in 2024 and priced at 91.75 to yield 5.19% to maturity.

- b. Texas Power and Light Co. 5½ due in 2019, rated AAA, and priced at 90 to yield 7.02% to maturity.

or

Arizona Public Service Co. 5.45 due in 2019, rated A–, and priced at 85 to yield 8.05% to maturity.

- c. Commonwealth Edison 2¾ due in 2018, rated Baa, and priced at 81 to yield 7.2% to maturity.

or

Commonwealth Edison 9¾ due in 2018, rated Baa, and priced at 114.40 to yield 7.2% to maturity.

- d. Shell Oil Co. 6½ sinking fund debentures due in 2023, rated AAA (sinking fund begins September 2010 at par), and priced at 89 to yield 7.1% to maturity.

or

Warner-Lambert 6¾ sinking fund debentures due in 2023, rated AAA (sinking fund begins April 2017 at par), and priced at 89 to yield 7.1% to maturity.

- e. Bank of Montreal (Canadian pay) 5% certificates of deposit due in 2012, rated AAA, and priced at 100 to yield 5% to maturity.

or

Bank of Montreal (Canadian pay) floating-rate note due in 2016, rated AAA. Coupon currently set at 3.7% and priced at 100 (coupon adjusted semiannually to .5% above the 3-month Government of Canada Treasury bill rate).

9. A member of a firm's investment committee is very interested in learning about the management of fixed-income portfolios. He would like to know how fixed-income managers position portfolios to capitalize on their expectations concerning three factors which influence interest rates:

- Changes in the level of interest rates.
- Changes in yield spreads across/between sectors.
- Changes in yield spreads as to a particular instrument.

Formulate and describe a fixed-income portfolio management strategy for each of these factors that could be used to exploit a portfolio manager's expectations about that factor. (*Note:* Three strategies are required, one for each of the listed factors.)

10. Carol Harrod is the investment officer for a \$100 million U.S. pension fund. The fixed-income portion of the portfolio is actively managed, and a substantial portion of the fund's large capitalization U.S. equity portfolio is indexed and managed by Webb Street Advisors.

Harrod has been impressed with the investment results of Webb Street's equity index strategy and is considering asking Webb Street to index a portion of the actively managed fixed-income portfolio.

- Describe advantages and disadvantages of bond indexing relative to active bond management.
- Webb Street manages indexed bond portfolios. Discuss how an indexed bond portfolio is constructed under stratified sampling (cellular) methods.
- Describe the main source of tracking error for the cellular method.

11. Janet Meer is a fixed-income portfolio manager. Noting that the current shape of the yield curve is flat, she considers the purchase of a newly issued, 7% coupon, 10-year maturity, option-free corporate bond priced at par. The bond has the following features:

Change in Yields		
	Up 10 Basis Points	Down 10 Basis Points
Price	99.29	100.71
Convexity measure	35.00	
Convexity adjustment	0.0035	

- a. Calculate the modified duration of the bond.
 b. Meer is also considering the purchase of a newly issued, 7.25% coupon, 12-year maturity option-free corporate bond. She wants to evaluate this second bond's price sensitivity to an instantaneous, downward parallel shift in the yield curve of 200 basis points. Based on the following data, what will be its price change in this yield-curve scenario?

Original issue price	Par value, to yield 7.25%
Modified duration (at original price)	7.90
Convexity measure	41.55
Convexity adjustment (yield change of 200 basis points)	1.66

- c. Meer asks her assistant to analyze several callable bonds, given the expected downward parallel shift in the yield curve. Meer's assistant argues that if interest rates fall enough, convexity for a callable bond will become negative. Is the assistant's argument correct?
12. Noah Kramer, a fixed-income portfolio manager based in the country of Sevista, is considering the purchase of a Sevista government bond. Kramer decides to evaluate two strategies for implementing his investment in Sevista bonds. Table 16A gives the details of the two strategies, and Table 16B contains the assumptions that apply to both strategies.

Before choosing one of the two bond-investment strategies, Kramer wants to analyze how the market value of the bonds will change if an instantaneous interest rate shift occurs immediately after his investment. The details of the interest rate shift are shown in Table 16C. Calculate, for the instantaneous interest rate shift shown in Table 16C, the percent change in the market value of the bonds that will occur under each strategy.

Strategy	5-Year Maturity (Modified Duration = 4.83)	15-Year Maturity (Modified Duration = 14.35)	25-Year Maturity (Modified Duration = 23.81)
I	\$5 million	0	\$5 million
II	0	\$10 million	0

Table 16A

Investment strategies (amounts are market value invested)

Market value of bonds	\$10 million
Bond maturities	5 and 25 years or 15 years
Bond coupon rates	0.00% (zero coupon)
Target modified duration	15 years

Table 16B

Investment strategy assumptions

Maturity	Interest Rate Change
5 year	Down 75 basis points (bps)
15 year	Up 25 bps
25 year	Up 50 bps

Table 16C

Instantaneous interest rate shift immediately after investment

13. As part of your analysis of debt issued by Monticello Corporation, you are asked to evaluate two of its bond issues, shown in the following table.

	Bond A (Callable)	Bond B (Noncallable)
Maturity	2020	2020
Coupon	11.50%	7.25%
Current price	125.75	100.00
Yield to maturity	7.70%	7.25%
Modified duration to maturity	6.20	6.80
Call date	2014	—
Call price	105	—
Yield to call	5.10%	—
Modified duration to call	3.10	—

- Using the duration and yield information in the table above, compare the price and yield behavior of the two bonds under each of the following two scenarios:
 - Strong economic recovery with rising inflation expectations.
 - Economic recession with reduced inflation expectations.
- Using the information in the table, calculate the projected price change for bond B if its yield to maturity falls by 75 basis points.
- Describe the shortcoming of analyzing bond A strictly to call or to maturity.

E-INVESTMENTS EXERCISES

Duration and Convexity Calculators

Go to www.investinginbonds.com/story.asp?id=207. Choose the link for the general-purpose bond calculator. The calculator provides yield to maturity, modified duration, and bond convexity as the bond's price changes. Experiment by trying different inputs. What happens to duration and convexity as coupon increases? As maturity increases? As price increases (holding coupon fixed)?

SOLUTIONS TO CONCEPT CHECKS

1. Use Spreadsheet 16.1 with a semiannual discount rate of 4.5%.

	Period	Time until Payment (Years)	Cash Flow	PV of CF (Discount rate = 4.5% per period)	Weight	Weight × Time
A. 8% coupon bond	1	0.5	40	38.278	0.0390	0.0195
	2	1.0	40	36.629	0.0373	0.0373
	3	1.5	40	35.052	0.0357	0.0535
	4	2.0	1040	<u>872.104</u>	<u>0.8880</u>	<u>1.7761</u>
Sum:			982.062	1.0000	1.8864	
B. Zero-coupon	1	0.5	0	0.000	0.0000	0.0000
	2	1.0	0	0.000	0.0000	0.0000
	3	1.5	0	0.000	0.0000	0.0000
	4	2.0	1000	<u>838.561</u>	<u>1.0000</u>	<u>2.0000</u>
Sum:			838.561	1.0000	2.0000	

The duration of the 8% coupon bond increases to 1.8864 years. Price increases to \$982.062. The duration of the zero-coupon bond is unchanged at 2 years, although its price also increases (to \$838.561) when the interest rate falls.

2. a. If the interest rate increases from 9% to 9.05%, the bond price falls from \$982.062 to \$981.177. The percentage change in price is -0.0901% .
- b. Using the initial semiannual rate of 4.5%, duration is 1.8864 years (see Concept Check 1), so the duration formula would predict a price change of

$$-\frac{1.8864}{1.045} \times .0005 = -.000903 = -.0903\%$$

which is almost the same answer that we obtained from direct computation in part (a).

3. The duration of a level perpetuity is $(1 + y)/y$ or $1 + 1/y$, which clearly falls as y increases. Tabulating duration as a function of y we get

y	D
.01	101 years
.02	51
.05	21
.10	11
.20	6
.25	5
.40	3.5

4. In accord with the duration rules presented in the chapter, you should find that duration is shorter when the coupon rate or yield to maturity is higher. Duration increases with maturity for most bonds. Duration is shorter when coupons are paid semiannually rather than annually because on average, payments come earlier. Instead of waiting until year-end to receive the annual coupon, investors receive half the coupon midyear.
5. Macaulay's duration is defined as the weighted average of the time until receipt of each bond payment. Modified duration is defined as Macaulay's duration divided by $1 + y$ (where y is yield per payment period, e.g., a semiannual yield if the bond pays semiannual coupons). One can demonstrate that for a straight bond, modified duration approximately equals the percentage change in bond price per change in yield. Effective duration captures this last property of modified duration. It is *defined* as percentage change in bond price per change in market interest rates. Effective duration for a bond with embedded options requires a valuation method that allows for such options in computing price changes. Effective duration cannot be related to a weighted average of times until payments, because those payments are themselves uncertain.
6. The perpetuity's duration now would be $1.08/.08 = 13.5$. We need to solve the following equation for w :

$$w \times 2 + (1 - w) \times 13.5 = 6$$

Therefore $w = .6522$.

7. Dedication would be more attractive. Cash flow matching eliminates the need for rebalancing and thus saves transaction costs.
8. Current price = \$1,091.29

$$\begin{aligned} \text{Forecasted price} &= \$100 \times \text{Annuity factor (10\%, 18years)} + \$1,000 \times \text{PV factor (10\%, 18 years)} \\ &= \$1,000 \end{aligned}$$

The future value of reinvested coupons will be $(\$100 \times 1.08) + \$100 = \$208$

$$\text{The 2-year return is } \frac{\$208 + (\$1,000 - \$1,091.29)}{\$1,091.29} = 0.107, \text{ or } 10.7\%$$

The annualized rate of return over the 2-year period would then be $(1.107)^{1/2} - 1 = .052$, or 5.2%.

PROBLEM SETS

i. Basic

ii. Intermediate

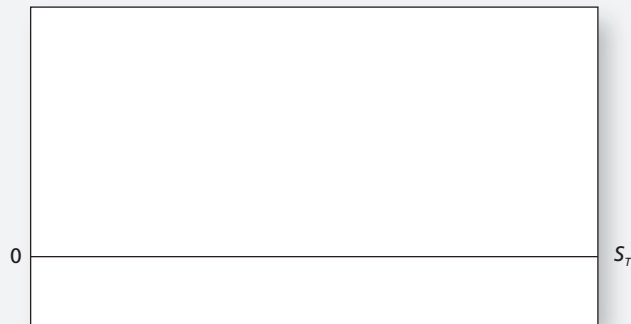
1. We said that options can be used either to scale up or reduce overall portfolio risk. What are some examples of risk-increasing and risk-reducing options strategies? Explain each.
2. What are the trade-offs facing an investor who is considering buying a put option on an existing portfolio?
3. What are the trade-offs facing an investor who is considering writing a call option on an existing portfolio?
4. Why do you think the most actively traded options tend to be the ones that are near the money?
5. Turn back to Figure 20.1, which lists prices of various IBM options. Use the data in the figure to calculate the payoff and the profits for investments in each of the following January expiration options, assuming that the stock price on the expiration date is \$125.
 - a. Call option, $X = \$120$.
 - b. Put option, $X = \$120$.
 - c. Call option, $X = \$125$.
 - d. Put option, $X = \$125$.
 - e. Call option, $X = \$130$.
 - f. Put option, $X = \$130$.
6. Suppose you think Walmart stock is going to appreciate substantially in value in the next 6 months. Say the stock's current price, S_0 , is \$100, and the call option expiring in 6 months has an exercise price, X , of \$100 and is selling at a price, C , of \$10. With \$10,000 to invest, you are considering three alternatives.
 - a. Invest all \$10,000 in the stock, buying 100 shares.
 - b. Invest all \$10,000 in 1,000 options (10 contracts).
 - c. Buy 100 options (one contract) for \$1,000, and invest the remaining \$9,000 in a money market fund paying 4% in interest over 6 months (8% per year).

What is your rate of return for each alternative for the following four stock prices 6 months from now? Summarize your results in the table and diagram below.

Price of Stock 6 Months from Now			
\$80	\$100	\$110	\$120

- a. All stocks (100 shares)
- b. All options (1,000 shares)
- c. Bills + 100 options

Rate of Return



7. The common stock of the P.U.T.T. Corporation has been trading in a narrow price range for the past month, and you are convinced it is going to break far out of that range in the next 3 months. You do not know whether it will go up or down, however. The current price of the stock is \$100 per share, and the price of a 3-month call option at an exercise price of \$100 is \$10.
 - a. If the risk-free interest rate is 10% per year, what must be the price of a 3-month put option on P.U.T.T. stock at an exercise price of \$100? (The stock pays no dividends.)

- b.* What would be a simple options strategy to exploit your conviction about the stock price's future movements? How far would it have to move in either direction for you to make a profit on your initial investment?
8. The common stock of the C.A.L.L. Corporation has been trading in a narrow range around \$50 per share for months, and you believe it is going to stay in that range for the next 3 months. The price of a 3-month put option with an exercise price of \$50 is \$4.
- a.* If the risk-free interest rate is 10% per year, what must be the price of a 3-month call option on C.A.L.L. stock at an exercise price of \$50 if it is at the money? (The stock pays no dividends.)
- b.* What would be a simple options strategy using a put and a call to exploit your conviction about the stock price's future movement? What is the most money you can make on this position? How far can the stock price move in either direction before you lose money?
- c.* How can you create a position involving a put, a call, and riskless lending that would have the same payoff structure as the stock at expiration? What is the net cost of establishing that position now?
9. You are a portfolio manager who uses options positions to customize the risk profile of your clients. In each case, what strategy is best given your client's objective?
- a.*
- Performance to date: Up 16%.
 - Client objective: Earn at least 15%.
 - Your scenario: Good chance of large gains or large losses between now and end of year.
 - i.* Long straddle.
 - ii.* Long bullish spread.
 - iii.* Short straddle.
- b.*
- Performance to date: Up 16%.
 - Client objective: Earn at least 15%.
 - Your scenario: Good chance of large losses between now and end of year.
 - i.* Long put options.
 - ii.* Short call options.
 - iii.* Long call options.
10. An investor purchases a stock for \$38 and a put for \$.50 with a strike price of \$35. The investor sells a call for \$.50 with a strike price of \$40. What is the maximum profit and loss for this position? Draw the profit and loss diagram for this strategy as a function of the stock price at expiration.
11. Imagine that you are holding 5,000 shares of stock, currently selling at \$40 per share. You are ready to sell the shares but would prefer to put off the sale until next year for tax reasons. If you continue to hold the shares until January, however, you face the risk that the stock will drop in value before year end. You decide to use a collar to limit downside risk without laying out a good deal of additional funds. January call options with a strike of \$35 are selling at \$2, and January puts with a strike price of \$45 are selling at \$3. What will be the value of your portfolio in January (net of the proceeds from the options) if the stock price ends up at: (*a*) \$30, (*b*) \$40, or (*c*) \$50? Compare these proceeds to what you would realize if you simply continued to hold the shares.
12. In this problem, we derive the put-call parity relationship for European options on stocks that pay dividends before option expiration. For simplicity, assume that the stock makes one dividend payment of \$ D per share at the expiration date of the option.
- a.* What is the value of a stock-plus-put position on the expiration date of the option?
- b.* Now consider a portfolio comprising a call option and a zero-coupon bond with the same maturity date as the option and with face value $(X + D)$. What is the value of this portfolio on the option expiration date? You should find that its value equals that of the stock-plus-put portfolio regardless of the stock price.
- c.* What is the cost of establishing the two portfolios in parts (*a*) and (*b*)? Equate the costs of these portfolios, and you will derive the put-call parity relationship, Equation 20.2.

KAPLAN
SCHWESER

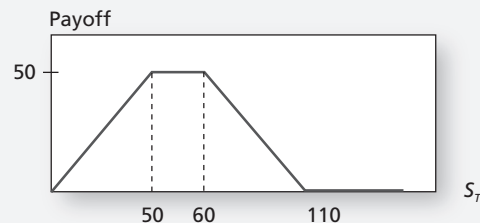
KAPLAN
SCHWESER

13. *a.* A butterfly spread is the purchase of one call at exercise price X_1 , the sale of two calls at exercise price X_2 , and the purchase of one call at exercise price X_3 . X_1 is less than X_2 , and X_2 is less than X_3 by equal amounts, and all calls have the same expiration date. Graph the payoff diagram to this strategy.
- b.* A vertical combination is the purchase of a call with exercise price X_2 and a put with exercise price X_1 , with X_2 greater than X_1 . Graph the payoff to this strategy.
14. A bearish spread is the purchase of a call with exercise price X_2 and the sale of a call with exercise price X_1 , with X_2 greater than X_1 . Graph the payoff to this strategy and compare it to Figure 20.10.
15. Joseph Jones, a manager at Computer Science, Inc. (CSI), received 10,000 shares of company stock as part of his compensation package. The stock currently sells at \$40 a share. Joseph would like to defer selling the stock until the next tax year. In January, however, he will need to sell all his holdings to provide for a down payment on his new house. Joseph is worried about the price risk involved in keeping his shares. At current prices, he would receive \$400,000 for the stock. If the value of his stock holdings falls below \$350,000, his ability to come up with the necessary down payment would be jeopardized. On the other hand, if the stock value rises to \$450,000, he would be able to maintain a small cash reserve even after making the down payment. Joseph considers three investment strategies:
- a.* Strategy A is to write January call options on the CSI shares with strike price \$45. These calls are currently selling for \$3 each.
- b.* Strategy B is to buy January put options on CSI with strike price \$35. These options also sell for \$3 each.
- c.* Strategy C is to establish a zero-cost collar by writing the January calls and buying the January puts.

Evaluate each of these strategies with respect to Joseph's investment goals. What are the advantages and disadvantages of each? Which would you recommend?

16. Use the spreadsheet from the Excel Application boxes on spreads and straddles (available at www.mhhe.com/bkm; link to Chapter 20 material) to answer these questions.
- a.* Plot the payoff and profit diagrams to a straddle position with an exercise (strike) price of \$130. Assume the options are priced as they are in the Excel Application.
- b.* Plot the payoff and profit diagrams to a bullish spread position with exercise (strike) prices of \$120 and \$130. Assume the options are priced as they are in the Excel Application.
17. The agricultural price support system guarantees farmers a minimum price for their output. Describe the program provisions as an option. What is the asset? The exercise price?
18. In what ways is owning a corporate bond similar to writing a put option? A call option?
19. An executive compensation scheme might provide a manager a bonus of \$1,000 for every dollar by which the company's stock price exceeds some cutoff level. In what way is this arrangement equivalent to issuing the manager call options on the firm's stock?
20. Consider the following options portfolio. You write a January expiration call option on IBM with exercise price 130. You write a January IBM put option with exercise price 125.
- a.* Graph the payoff of this portfolio at option expiration as a function of IBM's stock price at that time.
- b.* What will be the profit/loss on this position if IBM is selling at 128 on the option expiration date? What if IBM is selling at 135? Use *The Wall Street Journal* listing from Figure 20.1 to answer this question.
- c.* At what two stock prices will you just break even on your investment?
- d.* What kind of "bet" is this investor making; that is, what must this investor believe about IBM's stock price to justify this position?
21. Consider the following portfolio. You write a put option with exercise price 90 and buy a put option on the same stock with the same expiration date with exercise price 95.
- a.* Plot the value of the portfolio at the expiration date of the options.
- b.* On the same graph, plot the profit of the portfolio. Which option must cost more?

22. A Ford put option with strike price 60 trading on the Acme options exchange sells for \$2. To your amazement, a Ford put with the same maturity selling on the Apex options exchange but with strike price 62 also sells for \$2. If you plan to hold the options positions to maturity, devise a zero-net-investment arbitrage strategy to exploit the pricing anomaly. Draw the profit diagram at maturity for your position.
23. Assume a stock has a value of \$100. The stock is expected to pay a dividend of \$2 per share at year-end. An at-the-money European-style put option with one-year maturity sells for \$7. If the annual interest rate is 5%, what must be the price of a 1-year at-the-money European call option on the stock?
24. You buy a share of stock, write a 1-year call option with $X = \$10$, and buy a 1-year put option with $X = \$10$. Your net outlay to establish the entire portfolio is \$9.50. What is the risk-free interest rate? The stock pays no dividends.
25. You write a put option with $X = 100$ and buy a put with $X = 110$. The puts are on the same stock and have the same expiration date.
- Draw the payoff graph for this strategy.
 - Draw the profit graph for this strategy.
 - If the underlying stock has positive beta, does this portfolio have positive or negative beta?
26. Joe Finance has just purchased a stock index fund, currently selling at \$400 per share. To protect against losses, Joe also purchased an at-the-money European put option on the fund for \$20, with exercise price \$400, and 3-month time to expiration. Sally Calm, Joe's financial adviser, points out that Joe is spending a lot of money on the put. She notes that 3-month puts with strike prices of \$390 cost only \$15, and suggests that Joe use the cheaper put.
- Analyze Joe's and Sally's strategies by drawing the *profit* diagrams for the stock-plus-put positions for various values of the stock fund in 3 months.
 - When does Sally's strategy do better? When does it do worse?
 - Which strategy entails greater systematic risk?
27. You write a call option with $X = 50$ and buy a call with $X = 60$. The options are on the same stock and have the same expiration date. One of the calls sells for \$3; the other sells for \$9.
- Draw the payoff graph for this strategy at the option expiration date.
 - Draw the profit graph for this strategy.
 - What is the break-even point for this strategy? Is the investor bullish or bearish on the stock?
28. Devise a portfolio using only call options and shares of stock with the following value (payoff) at the option expiration date. If the stock price is currently 53, what kind of bet is the investor making?



29. You are attempting to formulate an investment strategy. On the one hand, you think there is great upward potential in the stock market and would like to participate in the upward move if it materializes. However, you are not able to afford substantial stock market losses and so cannot run the risk of a stock market collapse, which you think is also a possibility. Your investment adviser suggests a protective put position: Buy both shares in a market index stock fund and put options on those shares with 3-month expiration and exercise price of \$780. The stock index

iii. Challenge

fund is currently selling for \$900. However, your uncle suggests you instead buy a 3-month call option on the index fund with exercise price \$840 and buy 3-month T-bills with face value \$840.

- On the same graph, draw the *payoffs* to each of these strategies as a function of the stock fund value in 3 months. (*Hint*: Think of the options as being on one “share” of the stock index fund, with the current price of each share of the fund equal to \$900.)
- Which portfolio must require a greater initial outlay to establish? (*Hint*: Does either portfolio provide a final payout that is always at least as great as the payoff of the other portfolio?)
- Suppose the market prices of the securities are as follows:

Stock fund	\$900
T-bill (face value \$840)	\$810
Call (exercise price \$840)	\$120
Put (exercise price \$780)	\$ 6

Make a table of the profits realized for each portfolio for the following values of the stock price in 3 months: $S_T = \$700, \$840, \$900, \960 .

Graph the profits to each portfolio as a function of S_T on a single graph.

- Which strategy is riskier? Which should have a higher beta?
 - Explain why the data for the securities given in part (c) do *not* violate the put-call parity relationship.
- Using the IBM option prices in Figure 20.1, calculate the market price of a riskless zero-coupon bond with face value \$125 that matures in January on the same date as the listed options.
 - Demonstrate that an at-the-money call option on a given stock must cost more than an at-the-money put option on that stock with the same maturity. The stock will pay no dividends until after the expiration date. (*Hint*: Use put-call parity.)



- Donna Donie, CFA, has a client who believes the common stock price of TRT Materials (currently \$58 per share) could move substantially in either direction in reaction to an expected court decision involving the company. The client currently owns no TRT shares, but asks Donie for advice about implementing a strangle strategy to capitalize on the possible stock price movement. A strangle is a portfolio of a put and a call with different exercise prices but the same expiration date. Donie gathers the TRT option-pricing data:

Characteristic	Call Option	Put Option
Price	\$ 5	\$ 4
Strike price	\$60	\$55
Time to expiration	90 days from now	90 days from now

- Recommend whether Donie should choose a long strangle strategy or a short strangle strategy to achieve the client’s objective.
 - Calculate, at expiration for the appropriate strangle strategy in part (a), the:
 - Maximum possible loss per share.
 - Maximum possible gain per share.
 - Break-even stock price(s).
- Martin Bowman is preparing a report distinguishing traditional debt securities from structured note securities. Discuss how the following structured note securities differ from a traditional debt security with respect to coupon and principal payments:
 - Equity index-linked notes.
 - Commodity-linked bear bond.

3. Suresh Singh, CFA, is analyzing a convertible bond. The characteristics of the bond and the underlying common stock are given in the following exhibit:

Convertible Bond Characteristics	
Par value	\$1,000
Annual coupon rate (annual pay)	6.5%
Conversion ratio	22
Market price	105% of par value
Straight value	99% of par value
Underlying Stock Characteristics	
Current market price	\$40 per share
Annual cash dividend	\$1.20 per share

Compute the bond's:

- Conversion value.
 - Market conversion price.
4. Rich McDonald, CFA, is evaluating his investment alternatives in Ytel Incorporated by analyzing a Ytel convertible bond and Ytel common equity. Characteristics of the two securities are given in the following exhibit:

Characteristics	Convertible Bond	Common Equity
Par value	\$1,000	—
Coupon (annual payment)	4%	—
Current market price	\$980	\$35 per share
Straight bond value	\$925	—
Conversion ratio	25	—
Conversion option	At any time	—
Dividend	—	\$0
Expected market price in 1 year	\$1,125	\$45 per share

- Calculate, based on the exhibit, the:
 - Current market conversion price for the Ytel convertible bond.
 - Expected 1-year rate of return for the Ytel convertible bond.
 - Expected 1-year rate of return for the Ytel common equity.
- One year has passed and Ytel's common equity price has increased to \$51 per share. Also, over the year, the interest rate on Ytel's nonconvertible bonds of the same maturity increased, while credit spreads remained unchanged.
- Name the two components of the convertible bond's value. Indicate whether the value of each component should decrease, stay the same, or increase in response to the:
 - Increase in Ytel's common equity price.
 - Increase in interest rates.
5. *a.* Consider a bullish spread option strategy using a call option with a \$25 exercise price priced at \$4 and a call option with a \$40 exercise price priced at \$2.50. If the price of the stock increases to \$50 at expiration and each option is exercised on the expiration date, the net profit per share at expiration (ignoring transaction costs) is:
- \$8.50
 - \$13.50
 - \$16.50
 - \$23.50

- b. A put on XYZ stock with a strike price of \$40 is priced at \$2.00 per share, while a call with a strike price of \$40 is priced at \$3.50. What is the maximum per-share loss to the writer of the uncovered put and the maximum per-share gain to the writer of the uncovered call?

	Maximum Loss to Put Writer	Maximum Gain to Call Writer
i.	\$38.00	\$ 3.50
ii.	\$38.00	\$36.50
iii.	\$40.00	\$ 3.50
iv.	\$40.00	\$40.00

E-INVEST- MENTS EXERCISES

The Options Clearing Corporation

Most of your education in finance and financial markets focuses on the “front office” activities of investment analysis, trading, and broker or dealer interaction with investing customers. For every trade there is a “clearing” and a few days later, a “settlement.” This “back office” area of financial markets, though not in the spotlight, is an enormous operation, and a source of considerable employment opportunities. The Options Clearing Corporation discussed in this chapter is an excellent example. Go to the OCC home page (www.optionsclearing.com) and answer the following questions:

1. Click on the *Volume Statistics* link. How many equity option contracts were cleared by the OCC yesterday? How does this figure compare with the year-to-date (YTD) average daily volume?
2. Click the link for *Historical Volume Statistics*. For each of the most recent 3 months, calculate the percentages of total contract clearings that were equity contracts, index contracts, currency contracts, and futures contracts. Is there much variation among the months’ percentages?
3. Back on the home page, examine the *Who We Are* link under the *About OCC* menu. What is the mission of the OCC?
4. Click on the *Read More* link at the bottom of the *Who We Are* page. How does the “Three Tiered Backup System” provide the OCC with a AAA rating? What programs does the OCC employ to promote liquidity for its members?
5. Go back to the home page and visit the *Career Center*. Where is the OCC located? What are the current employment opportunities with the OCC?

SOLUTIONS TO CONCEPT CHECKS

1. a. Denote the stock price at option expiration by S_T , and the exercise price by X . Value at expiration = $S_T - X = S_T - \$100$ if this value is positive; otherwise the call expires worthless.
Profit = Final value – Price of call option = Proceeds – \$6.00.

	$S_T = \$115$	$S_T = \$135$
Proceeds	\$0	\$10
Profits	–\$4.75	\$ 5.25

b. Value at expiration = $X - S_T = \$100 - S_T$ if this value is positive; otherwise the put expires worthless.

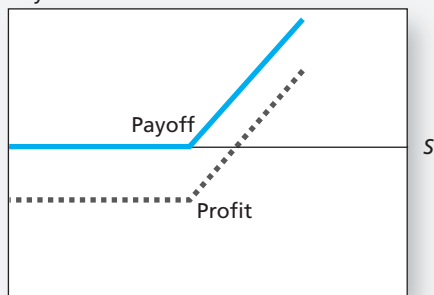
Profit = Final value - Price of put option = Proceeds - \$1.25.

	$S_T = \$115$	$S_T = \$135$
Proceeds	\$10	\$0
Profits	-\$ 7.56	-\$ 2.44

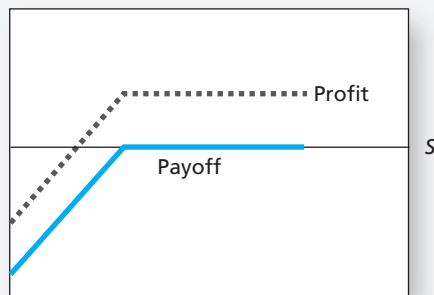
2. Before the split, the final payoff would have been $100 \times (\$140 - \$130) = \$1,000$. After the split, the payoff is $200 \times (\$70 - \$65) = \$1,000$. The payoff is unaffected.

3. a.

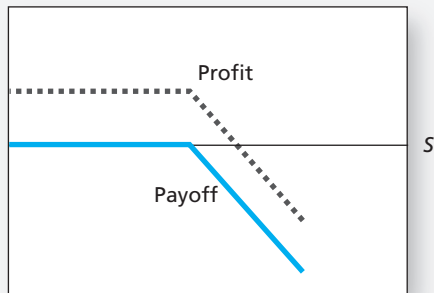
Buy Call



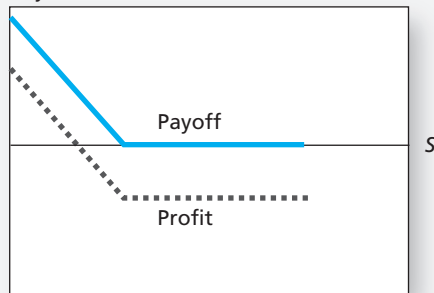
Write Put



Write Call



Buy Put

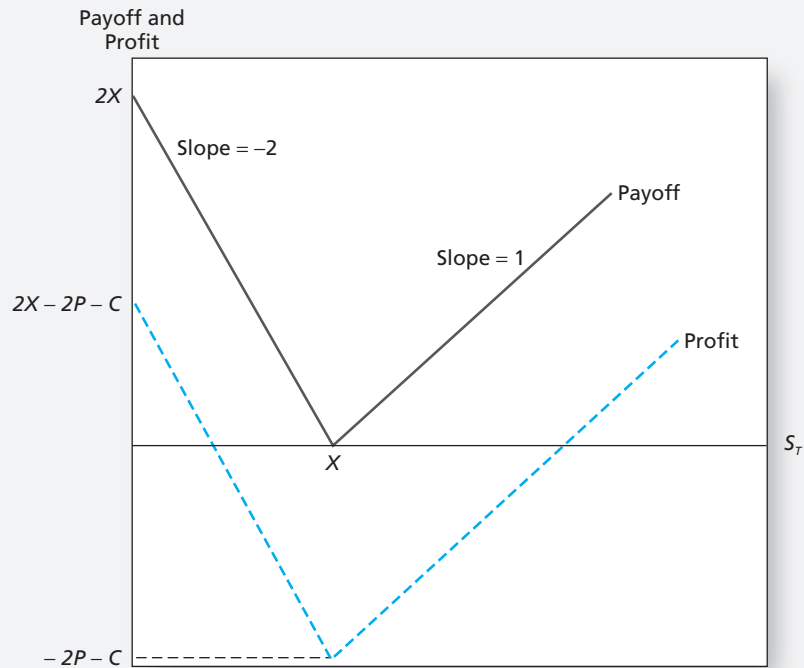


b. The payoffs and profits to both buying calls and writing puts generally are higher when the stock price is higher. In this sense, both positions are bullish. Both involve potentially taking delivery of the stock. However, the call holder will *choose* to take delivery when the stock price is high, while the put writer is *obligated* to take delivery when the stock price is low.

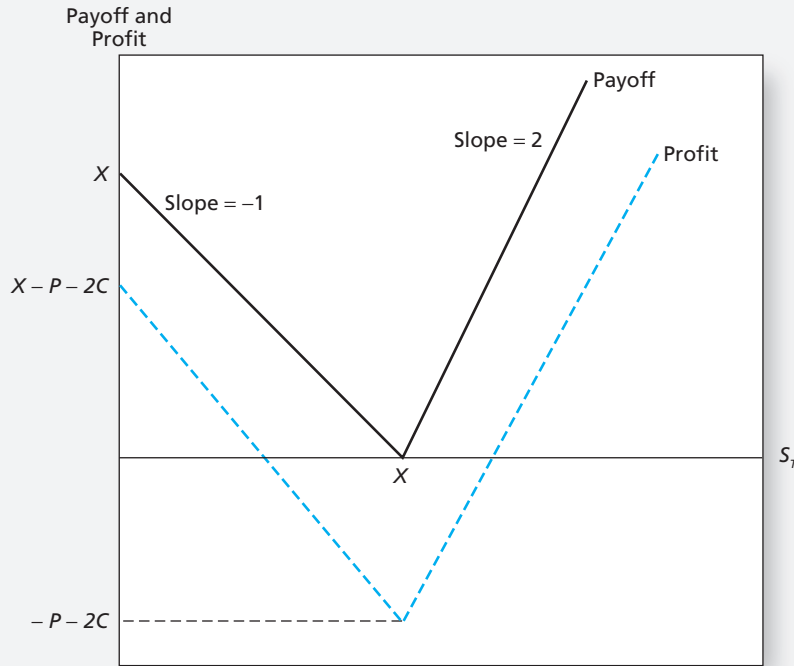
- c. The payoffs and profits to both writing calls and buying puts generally are higher when the stock price is lower. In this sense, both positions are bearish. Both involve potentially making delivery of the stock. However, the put holder will *choose* to make delivery when the stock price is low, while the call writer is *obligated* to make delivery when the stock price is high.

4. **Payoff to a Strip**

	$S_T \leq X$	$S_T > X$
2 Puts	$2(X - S_T)$	0
1 Call	0	$S_T - X$

**Payoff to a Strap**

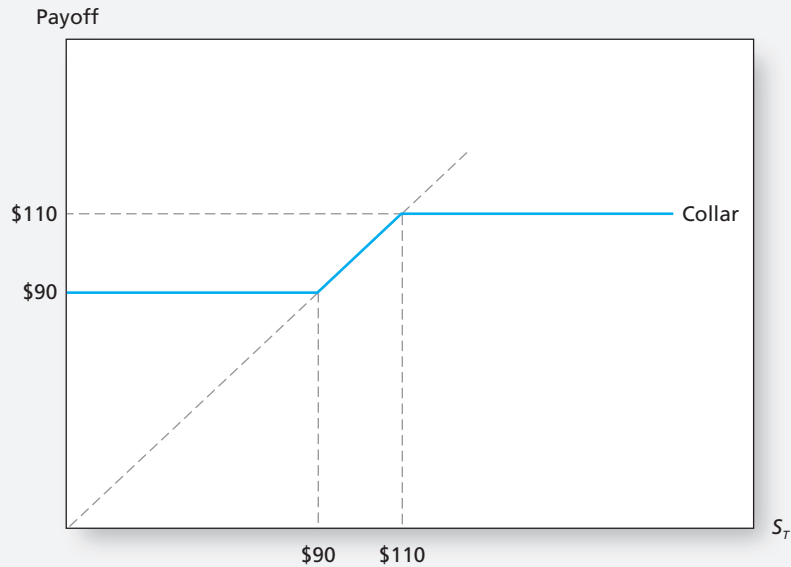
	$S_T \leq X$	$S_T > X$
1 Put	$X - S_T$	0
2 Calls	0	$2(S_T - X)$



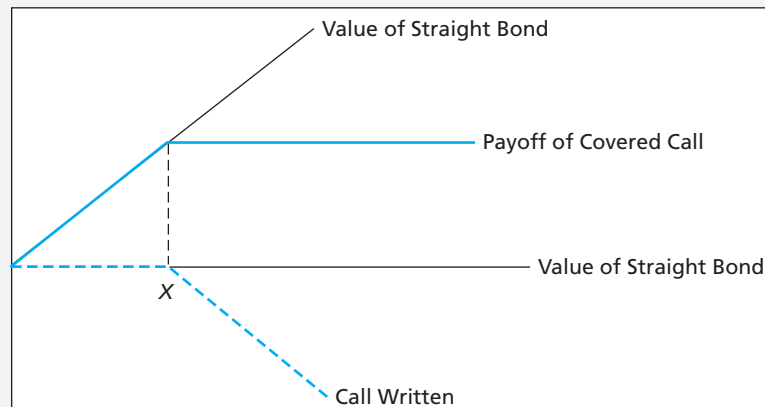
5. The payoff table on a per-share basis is as follows:

	$S_T \leq 90$	$90 \leq S_T \leq 110$	$S_T > 110$
Buy put ($X = 90$)	$90 - S_T$	0	0
Share	S_T	S_T	S_T
Write call ($X = 110$)	0	0	$-(S_T - 110)$
<i>TOTAL</i>	90	S_T	110

The graph of the payoff is as follows. If you multiply the per-share values by 2,000, you will see that the collar provides a minimum payoff of \$180,000 (representing a maximum loss of \$20,000) and a maximum payoff of \$220,000 (which is the cost of the house).



6. The covered call strategy would consist of a straight bond with a call written on the bond. The value of the strategy at option expiration as a function of the value of the straight bond is given by the solid colored payoff line in the figure following, which is virtually identical to Figure 20.11.



7. The call option is worth less as call protection is expanded. Therefore, the coupon rate need not be as high.
8. Lower. Investors will accept a lower coupon rate in return for the conversion option.
9. The depositor's implicit cost per dollar invested is now only $(\$0.03 - \$0.005)/1.03 = \$0.02427$ per 6-month period. Calls cost $50/1,000 = \$0.05$ per dollar invested in the index. The multiplier falls to $.02427/.05 = .4854$.

case of the binomial option model, as the holding period is divided into progressively smaller subperiods when the interest rate and stock volatility are constant.

5. The Black-Scholes formula applies to options on stocks that pay no dividends. Dividend adjustments may be adequate to price European calls on dividend-paying stocks, but the proper treatment of American calls on dividend-paying stocks requires more complex formulas.
6. Put options may be exercised early, whether the stock pays dividends or not. Therefore, American puts generally are worth more than European puts.
7. European put values can be derived from the call value and the put-call parity relationship. This technique cannot be applied to American puts for which early exercise is a possibility.
8. The implied volatility of an option is the standard deviation of stock returns consistent with an option's market price. It can be backed out of an option-pricing model by finding the stock volatility that makes the option's value equal to its observed price.
9. The hedge ratio is the number of shares of stock required to hedge the price risk involved in writing one option. Hedge ratios are near zero for deep out-of-the-money call options and approach 1.0 for deep in-the-money calls.
10. Although hedge ratios are less than 1.0, call options have elasticities greater than 1.0. The rate of return on a call (as opposed to the dollar return) responds more than one-for-one with stock price movements.
11. Portfolio insurance can be obtained by purchasing a protective put option on an equity position. When the appropriate put is not traded, portfolio insurance entails a dynamic hedge strategy where a fraction of the equity portfolio equal to the desired put option's delta is sold and placed in risk-free securities.
12. The option delta is used to determine the hedge ratio for options positions. Delta-neutral portfolios are independent of price changes in the underlying asset. Even delta-neutral option portfolios are subject to volatility risk, however.
13. Empirically, implied volatilities derived from the Black-Scholes formula tend to be lower on options with higher exercise prices. This may be evidence that the option prices reflect the possibility of a sudden dramatic decline in stock prices. Such "crashes" are inconsistent with the Black-Scholes assumptions.

Related Web sites for this chapter are available at www.mhhe.com/bkm

intrinsic value

time value

binomial model

Black-Scholes pricing formula

implied volatility

pseudo-American call option

value

hedge ratio

delta

option elasticity

portfolio insurance

dynamic hedging

gamma

delta neutral

vega

KEY TERMS

1. We showed in the text that the value of a call option increases with the volatility of the stock. Is this also true of put option values? Use the put-call parity theorem as well as a numerical example to prove your answer.
2. Would you expect a \$1 increase in a call option's exercise price to lead to a decrease in the option's value of more or less than \$1?
3. Is a put option on a high-beta stock worth more than one on a low-beta stock? The stocks have identical firm-specific risk.
4. All else equal, is a call option on a stock with a lot of firm-specific risk worth more than one on a stock with little firm-specific risk? The betas of the two stocks are equal.
5. All else equal, will a call option with a high exercise price have a higher or lower hedge ratio than one with a low exercise price?

PROBLEM SETS

i. Basic

ii. Intermediate

6. In each of the following questions, you are asked to compare two options with parameters as given. The risk-free interest rate for *all* cases should be assumed to be 6%. Assume the stocks on which these options are written pay no dividends.

a.

Put	T	X	σ	Price of Option
A	.5	50	.20	\$10
B	.5	50	.25	\$10

Which put option is written on the stock with the lower price?

- i. A.
- ii. B.
- iii. Not enough information.

b.

Put	T	X	σ	Price of Option
A	.5	50	.2	\$10
B	.5	50	.2	\$12

Which put option must be written on the stock with the lower price?

- i. A.
- ii. B.
- iii. Not enough information.

c.

Call	S	X	σ	Price of Option
A	50	50	.20	\$12
B	55	50	.20	\$10

Which call option must have the lower time to expiration?

- i. A.
- ii. B.
- iii. Not enough information.

d.

Call	T	X	S	Price of Option
A	.5	50	55	\$10
B	.5	50	55	\$12

Which call option is written on the stock with higher volatility?

- i. A.
- ii. B.
- iii. Not enough information.

e.

Call	T	X	S	Price of Option
A	.5	50	55	\$10
B	.5	50	55	\$ 7

Which call option is written on the stock with higher volatility?

- i. A.
- ii. B.
- iii. Not enough information.

7. Reconsider the determination of the hedge ratio in the two-state model (see page 719), where we showed that one-third share of stock would hedge one option. What would be the hedge ratio for the following exercise prices: 120, 110, 100, 90? What do you conclude about the hedge ratio as the option becomes progressively more in the money?
8. Show that Black-Scholes call option hedge ratios also increase as the stock price increases. Consider a 1-year option with exercise price \$50, on a stock with annual standard deviation 20%. The T-bill rate is 3% per year. Find $N(d_1)$ for stock prices \$45, \$50, and \$55.

9. We will derive a two-state put option value in this problem. Data: $S_0 = 100$; $X = 110$; $1 + r = 1.10$. The two possibilities for S_T are 130 and 80.
- Show that the range of S is 50, whereas that of P is 30 across the two states. What is the hedge ratio of the put?
 - Form a portfolio of three shares of stock and five puts. What is the (nonrandom) payoff to this portfolio? What is the present value of the portfolio?
 - Given that the stock currently is selling at 100, solve for the value of the put.
10. Calculate the value of a call option on the stock in the previous problem with an exercise price of 110. Verify that the put-call parity theorem is satisfied by your answers to Problems 9 and 10. (Do not use continuous compounding to calculate the present value of X in this example because we are using a two-state model here, not a continuous-time Black-Scholes model.)
11. Use the Black-Scholes formula to find the value of a call option on the following stock:
- | | |
|--------------------|--------------|
| Time to expiration | 6 months |
| Standard deviation | 50% per year |
| Exercise price | \$50 |
| Stock price | \$50 |
| Interest rate | 3% |
12. Find the Black-Scholes value of a put option on the stock in the previous problem with the same exercise price and expiration as the call option.
13. Recalculate the value of the call option in Problem 11, successively substituting one of the changes below while keeping the other parameters as in Problem 11:
- Time to expiration = 3 months.
 - Standard deviation = 25% per year.
 - Exercise price = \$55.
 - Stock price = \$55.
 - Interest rate = 5%.

Consider each scenario independently. Confirm that the option value changes in accordance with the prediction of Table 21.1.

14. A call option with $X = \$50$ on a stock currently priced at $S = \$55$ is selling for \$10. Using a volatility estimate of $\sigma = .30$, you find that $N(d_1) = .6$ and $N(d_2) = .5$. The risk-free interest rate is zero. Is the implied volatility based on the option price more or less than .30? Explain.
15. What would be the Excel formula in Spreadsheet 21.1 for the Black-Scholes value of a straddle position?

Use the following case in answering Problems 16–21: Mark Washington, CFA, is an analyst with BIC. One year ago, BIC analysts predicted that the U.S. equity market would most likely experience a slight downturn and suggested delta-hedging the BIC portfolio. As predicted, the U.S. equity markets did indeed experience a downturn of approximately 4% over a 12-month period. However, portfolio performance for BIC was disappointing, lagging its peer group by nearly 10%. Washington has been told to review the options strategy to determine why the hedged portfolio did not perform as expected.

16. Which of the following *best* explains a delta-neutral portfolio? A delta-neutral portfolio is perfectly hedged against:
- Small price changes in the underlying asset.
 - Small price decreases in the underlying asset.
 - All price changes in the underlying asset.
17. After discussing the concept of a delta-neutral portfolio, Washington determines that he needs to further explain the concept of delta. Washington draws the value of an option as a function of the underlying stock price. Using this diagram, indicate how delta is interpreted. Delta is the:
- Slope in the option price diagram.
 - Curvature of the option price graph.
 - Level in the option price diagram.

18. Washington considers a put option that has a delta of -0.65 . If the price of the underlying asset decreases by \$6, then what is the best estimate of the change in option price?
19. BIC owns 51,750 shares of Smith & Oates. The shares are currently priced at \$69. A call option on Smith & Oates with a strike price of \$70 is selling at \$3.50 and has a delta of .69. What is the number of call options necessary to create a delta-neutral hedge?
20. Return to the previous problem. Will the number of call options written for a delta-neutral hedge increase or decrease if the stock price falls?
21. Which of the following statements regarding the goal of a delta-neutral portfolio is *most* accurate? One example of a delta-neutral portfolio is to combine a:
 - a. Long position in a stock with a short position in call options so that the value of the portfolio does not change with changes in the value of the stock.
 - b. Long position in a stock with a short position in a call option so that the value of the portfolio changes with changes in the value of the stock.
 - c. Long position in a stock with a long position in call options so that the value of the portfolio does not change with changes in the value of the stock.
22. Should the rate of return of a call option on a long-term Treasury bond be more or less sensitive to changes in interest rates than is the rate of return of the underlying bond?
23. If the stock price falls and the call price rises, then what has happened to the call option's implied volatility?
24. If the time to expiration falls and the put price rises, then what has happened to the put option's implied volatility?
25. According to the Black-Scholes formula, what will be the value of the hedge ratio of a call option as the stock price becomes infinitely large? Explain briefly.
26. According to the Black-Scholes formula, what will be the value of the hedge ratio of a put option for a very small exercise price?
27. The hedge ratio of an at-the-money call option on IBM is .4. The hedge ratio of an at-the-money put option is $-.6$. What is the hedge ratio of an at-the-money straddle position on IBM?
28. Consider a 6-month expiration European call option with exercise price \$105. The underlying stock sells for \$100 a share and pays no dividends. The risk-free rate is 5%. What is the implied volatility of the option if the option currently sells for \$8? Use Spreadsheet 21.1 (available at www.mhhe.com/bkm; link to Chapter 21 material) to answer this question.
 - a. Go to the Tools menu of the spreadsheet and select Goal Seek. The dialog box will ask you for three pieces of information. In that dialog box, you should *set cell E6 to value 8 by changing cell B2*. In other words, you ask the spreadsheet to find the value of standard deviation (which appears in cell B2) that forces the value of the option (in cell E6) equal to \$8. Then click OK, and you should find that the call is now worth \$8, and the entry for standard deviation has been changed to a level consistent with this value. This is the call's implied standard deviation at a price of \$8.
 - b. What happens to implied volatility if the option is selling at \$9? Why has implied volatility increased?
 - c. What happens to implied volatility if the option price is unchanged at \$8, but option expiration is lower, say, only 4 months? Why?
 - d. What happens to implied volatility if the option price is unchanged at \$8, but the exercise price is lower, say, only \$100? Why?
 - e. What happens to implied volatility if the option price is unchanged at \$8, but the stock price is lower, say, only \$98? Why?
29. A collar is established by buying a share of stock for \$50, buying a 6-month put option with exercise price \$45, and writing a 6-month call option with exercise price \$55. On the basis of the volatility of the stock, you calculate that for a strike price of \$45 and expiration of 6 months, $N(d_1) = .60$, whereas for the exercise price of \$55, $N(d_1) = .35$.
 - a. What will be the gain or loss on the collar if the stock price increases by \$1?
 - b. What happens to the delta of the portfolio if the stock price becomes very large? Very small?

30. These three put options are all written on the same stock. One has a delta of $-.9$, one a delta of $-.5$, and one a delta of $-.1$. Assign deltas to the three puts by filling in this table.

Put	X	Delta
A	10	
B	20	
C	30	

31. You are *very* bullish (optimistic) on stock EFG, much more so than the rest of the market. In each question, choose the portfolio strategy that will give you the biggest dollar profit if your bullish forecast turns out to be correct. Explain your answer.
- Choice A: \$10,000 invested in calls with $X = 50$.
Choice B: \$10,000 invested in EFG stock.
 - Choice A: 10 call option contracts (for 100 shares each), with $X = 50$.
Choice B: 1,000 shares of EFG stock.
32. You would like to be holding a protective put position on the stock of XYZ Co. to lock in a guaranteed minimum value of \$100 at year-end. XYZ currently sells for \$100. Over the next year the stock price will increase by 10% or decrease by 10%. The T-bill rate is 5%. Unfortunately, no put options are traded on XYZ Co.
- Suppose the desired put option were traded. How much would it cost to purchase?
 - What would have been the cost of the protective put portfolio?
 - What portfolio position in stock and T-bills will ensure you a payoff equal to the payoff that would be provided by a protective put with $X = 100$? Show that the payoff to this portfolio and the cost of establishing the portfolio matches that of the desired protective put.
33. Return to Example 21.1. Use the binomial model to value a 1-year European put option with exercise price \$110 on the stock in that example. Does your solution for the put price satisfy put-call parity?
34. Suppose that the risk-free interest rate is zero. Would an American put option ever be exercised early? Explain.
35. Let $p(S, T, X)$ denote the value of a European put on a stock selling at S dollars, with time to maturity T , and with exercise price X , and let $P(S, T, X)$ be the value of an American put.
- Evaluate $p(0, T, X)$.
 - Evaluate $P(0, T, X)$.
 - Evaluate $p(S, T, 0)$.
 - Evaluate $P(S, T, 0)$.
 - What does your answer to (b) tell you about the possibility that American puts may be exercised early?
36. You are attempting to value a call option with an exercise price of \$100 and 1 year to expiration. The underlying stock pays no dividends, its current price is \$100, and you believe it has a 50% chance of increasing to \$120 and a 50% chance of decreasing to \$80. The risk-free rate of interest is 10%. Calculate the call option's value using the two-state stock price model.
37. Consider an increase in the volatility of the stock in the previous problem. Suppose that if the stock increases in price, it will increase to \$130, and that if it falls, it will fall to \$70. Show that the value of the call option is now higher than the value derived in the previous problem.
38. Calculate the value of a put option with exercise price \$100 using the data in Problem 36. Show that put-call parity is satisfied by your solution.
39. XYZ Corp. will pay a \$2 per share dividend in 2 months. Its stock price currently is \$60 per share. A call option on XYZ has an exercise price of \$55 and 3-month time to expiration. The risk-free interest rate is .5% per month, and the stock's volatility (standard deviation) = 7% per month. Find the pseudo-American option value. (Hint: Try defining one "period" as a month, rather than as a year.)
40. "The beta of a call option on General Electric is greater than the beta of a share of General Electric." True or false?

41. “The beta of a call option on the S&P 500 index with an exercise price of 1,130 is greater than the beta of a call on the index with an exercise price of 1,140.” True or false?
42. What will happen to the hedge ratio of a convertible bond as the stock price becomes very large?
43. Goldman Sachs believes that market volatility will be 20% annually for the next 3 years. Three-year at-the-money call and put options on the market index sell at an implied volatility of 22%. What options portfolio can Goldman establish to speculate on its volatility belief without taking a bullish or bearish position on the market? Using Goldman’s estimate of volatility, 3-year at-the-money options have $N(d_1) = .6$.
44. You are holding call options on a stock. The stock’s beta is .75, and you are concerned that the stock market is about to fall. The stock is currently selling for \$5 and you hold 1 million options on the stock (i.e., you hold 10,000 contracts for 100 shares each). The option delta is .8. How much of the market index portfolio must you buy or sell to hedge your market exposure?
- iii. Challenge
45. Imagine you are a provider of portfolio insurance. You are establishing a 4-year program. The portfolio you manage is currently worth \$100 million, and you hope to provide a minimum return of 0%. The equity portfolio has a standard deviation of 25% per year, and T-bills pay 5% per year. Assume for simplicity that the portfolio pays no dividends (or that all dividends are reinvested).
- How much should be placed in bills? How much in equity?
 - What should the manager do if the stock portfolio falls by 3% on the first day of trading?
46. Suppose that call options on ExxonMobil stock with time to expiration 3 months and strike price \$60 are selling at an implied volatility of 30%. ExxonMobil stock currently is \$60 per share, and the risk-free rate is 4%. If you believe the true volatility of the stock is 32%, how can you trade on your belief without taking on exposure to the performance of ExxonMobil? How many shares of stock will you hold for each option contract purchased or sold?
47. Using the data in the previous problem, suppose that 3-month put options with a strike price of \$60 are selling at an implied volatility of 34%. Construct a delta-neutral portfolio comprising positions in calls and puts that will profit when the option prices come back into alignment.
48. Suppose that JPMorgan Chase sells call options on \$1.25 million worth of a stock portfolio with beta = 1.5. The option delta is .8. It wishes to hedge out its resultant exposure to a market advance by buying a market index portfolio.
- How many dollars worth of the market index portfolio should it purchase to hedge its position?
 - What if it instead uses market index puts to hedge its exposure? Should it buy or sell puts? Each put option is on 100 units of the index, and the index at current prices represents \$1,000 worth of stock.



1. The board of directors of Abco Company is concerned about the downside risk of a \$100 million equity portfolio in its pension plan. The board’s consultant has proposed temporarily (for 1 month) hedging the portfolio with either futures or options. Referring to the following table, the consultant states:
- “The \$100 million equity portfolio can be fully protected on the downside by selling (shorting) 4,000 futures contracts.”
 - “The cost of this protection is that the portfolio’s expected rate of return will be zero percent.”

Market, Portfolio, and Contract Data

Equity index level	99.00
Equity futures price	100.00
Futures contract multiplier	\$250
Portfolio beta	1.20
Contract expiration (months)	3

Critique the accuracy of each of the consultant’s two statements.

2. Michael Weber, CFA, is analyzing several aspects of option valuation, including the determinants of the value of an option, the characteristics of various models used to value options, and the potential for divergence of calculated option values from observed market prices.
 - a. What is the expected effect on the value of a call option on common stock if the volatility of the underlying stock price decreases? If the time to expiration of the option increases?
 - b. Using the Black-Scholes option-pricing model, Weber calculates the price of a 3-month call option and notices the option's calculated value is different from its market price. With respect to Weber's use of the Black-Scholes option-pricing model,
 - i. Discuss why the calculated value of an out-of-the-money European option may differ from its market price.
 - ii. Discuss why the calculated value of an American option may differ from its market price.
3. Joel Franklin is a portfolio manager responsible for derivatives. Franklin observes an American-style option and a European-style option with the same strike price, expiration, and underlying stock. Franklin believes that the European-style option will have a higher premium than the American-style option.
 - a. Critique Franklin's belief that the European-style option will have a higher premium. Franklin is asked to value a 1-year European-style call option for Abaco Ltd. common stock, which last traded at \$43.00. He has collected the information in the following table.

Closing stock price	\$43.00
Call and put option exercise price	45.00
1-year put option price	4.00
1-year Treasury bill rate	5.50%
Time to expiration	One year

- b. Calculate, using put-call parity and the information provided in the table, the European-style call option value.
- c. State the effect, if any, of each of the following three variables on the value of a call option. (No calculations required.)
 - i. An increase in short-term interest rate.
 - ii. An increase in stock price volatility.
 - iii. A decrease in time to option expiration.
4. A stock index is currently trading at 50. Paul Tripp, CFA, wants to value 2-year index options using the binomial model. The stock will either increase in value by 20% or fall in value by 20%. The annual risk-free interest rate is 6%. No dividends are paid on any of the underlying securities in the index.
 - a. Construct a two-period binomial tree for the value of the stock index.
 - b. Calculate the value of a European call option on the index with an exercise price of 60.
 - c. Calculate the value of a European put option on the index with an exercise price of 60.
 - d. Confirm that your solutions for the values of the call and the put satisfy put-call parity.
5. Ken Webster manages a \$200 million equity portfolio benchmarked to the S&P 500 index. Webster believes the market is overvalued when measured by several traditional fundamental/economic indicators. He is concerned about potential losses but recognizes that the S&P 500 index could nevertheless move above its current 1136 level.

Webster is considering the following *option collar* strategy:

 - Protection for the portfolio can be attained by purchasing an S&P 500 index put with a strike price of 1130 (just out of the money).
 - The put can be financed by selling two 1150 calls (farther out-of-the-money) for every put purchased.
 - Because the combined delta of the two calls (see following table) is less than 1 (that is, $2 \times .36 = .72$), the options will not lose more than the underlying portfolio will gain if the market advances.

The information in the following table describes the two options used to create the collar.

Characteristics	1150 Call	1130 Put
Option price	\$8.60	\$16.10
Option implied volatility	22%	24%
Option's delta	0.36	-0.44
Contracts needed for collar	602	301

Notes:

- Ignore transaction costs.
- S&P 500 historical 30-day volatility = 23%.
- Time to option expiration = 30 days.

- Describe the potential returns of the combined portfolio (the underlying portfolio plus the option collar) if after 30 days the S&P 500 index has:
 - risen approximately 5% to 1193.
 - remained at 1136 (no change).
 - declined by approximately 5% to 1080.
 (No calculations are necessary.)
- Discuss the effect on the hedge ratio (delta) of *each* option as the S&P 500 approaches the level for *each* of the potential outcomes listed in part (a).
- Evaluate the pricing of *each* of the following in relation to the volatility data provided:
 - the put
 - the call

E-INVEST- MENTS EXERCISES

Option Price Differences

Select a stock for which options are listed on the CBOE Web site (www.cboe.com). The price data for captions can be found on the "delayed quotes" menu option. Enter a ticker symbol for a stock of your choice and pull up its option price data.

Using daily price data from finance.yahoo.com calculate the annualized standard deviation of the daily percentage change in the stock price. Create a Black-Scholes option-pricing model in a spreadsheet, or use our Spreadsheet 21.1, available at www.mhhe.com/bkm with Chapter 21 material. Using the standard deviation and a risk-free rate found at www.bloomberg.com/markets/rates/index.html, calculate the value of the call options.

How do the calculated values compare to the market prices of the options? On the basis of the difference between the price you calculated using historical volatility and the actual price of the option, what do you conclude about expected trends in market volatility?

SOLUTIONS TO CONCEPT CHECKS

1. If This Variable Increases . . . The Value of a Put Option

S	Decreases
X	Increases
σ	Increases
T	Increases*
r_f	Decreases
Dividend payouts	Increases

*For American puts, increase in time to expiration must increase value. One can always choose to exercise early if this is optimal; the longer expiration date simply expands the range of alternatives open to the option holder which must make the option more valuable. For a European put, where early exercise is not allowed, longer time to expiration can have an indeterminate effect. Longer expiration increases volatility value because the final stock price is more uncertain, but it reduces the present value of the exercise price that will be received if the put is exercised. The net effect on put value is ambiguous.

To understand the impact of higher volatility, consider the same scenarios as for the call. The low-volatility scenario yields a lower expected payoff.

High	Stock price	\$10	\$20	\$30	\$40	\$50
volatility	Put payoff	\$20	\$10	\$ 0	\$ 0	\$ 0
Low	Stock price	\$20	\$25	\$30	\$35	\$40
volatility	Put payoff	\$10	\$ 5	\$ 0	\$ 0	\$ 0

2. The parity relationship assumes that all options are held until expiration and that there are no cash flows until expiration. These assumptions are valid only in the special case of European options on non-dividend-paying stocks. If the stock pays no dividends, the American and European calls are equally valuable, whereas the American put is worth more than the European put. Therefore, although the parity theorem for European options states that

$$P = C - S_0 + PV(X)$$

in fact, P will be *greater* than this value if the put is American.

3. Because the option now is underpriced, we want to reverse our previous strategy.

	Initial Cash Flow	Cash Flow in 1 Year for Each Possible Stock Price	
		$S = 90$	$S = 120$
Buy 3 options	-16.50	0	30
Short-sell 1 share; repay in 1 year	100	-90	-120
Lend \$83.50 at 10% interest rate	-83.50	91.85	91.85
TOTAL	0	1.85	1.85

The riskless cash flow in 1 year per option is $\$1.85/3 = \0.6167 , and the present value is $\$0.6167/1.10 = \0.56 , precisely the amount by which the option is underpriced.

4. a. $C_u - C_d = \$6.984 - 0$
 b. $uS_0 - dS_0 = \$110 - \$95 = \$15$
 c. $6.984/15 = .4656$
 d.

Action Today (time 0)	Value in Next Period as Function of Stock Price	
	$dS_0 = \$95$	$uS_0 = \$110$
Buy .4656 shares at price $S_0 = \$100$	\$44.232	\$51.216
Write 1 call at price C_0	0	-6.984
TOTAL	\$44.232	\$44.232

The portfolio must have a market value equal to the present value of \$44.232.

$$e. \$44.232/1.05 = \$42.126$$

$$f. .4656 \times \$100 - C_0 = \$42.126$$

$$C_0 = \$46.56 - \$42.126 = \$4.434$$

5. Higher. For deep out-of-the-money call options, an increase in the stock price still leaves the option unlikely to be exercised. Its value increases only fractionally. For deep in-the-money options, exercise is likely, and option holders benefit by a full dollar for each dollar increase in the stock, as though they already own the stock.
6. Because $\sigma = .6$, $\sigma^2 = .36$.

$$d_1 = \frac{\ln(100/95) + (.10 + .36/2) \cdot .25}{.6\sqrt{.25}} = .4043$$

$$d_2 = d_1 - .6\sqrt{.25} = .1043$$

Using Table 21.2 and interpolation, or from a spreadsheet function:

$$N(d_1) = .6570$$

$$N(d_2) = .5415$$

$$C = 100 \times .6570 - 95e^{-.10 \times .25} \times .5415 = 15.53$$

7. Implied volatility exceeds .2783. Given a standard deviation of .2783, the option value is \$7. A higher volatility is needed to justify an \$8 price. Using Spreadsheet 21.1 and Goal Seek, you can confirm that implied volatility at an option price of \$8 is .3138.
8. A \$1 increase in stock price is a percentage increase of $1/122 = .82\%$. The put option will fall by $(.4 \times \$1) = \$.40$, a percentage decrease of $\$.40/\$4 = 10\%$. Elasticity is $-10/.82 = -12.2$.
9. The delta for a call option is $N(d_1)$, which is positive, and in this case is .547. Therefore, for every 10 option contracts purchased, you would need to *short* 547 shares of stock.