

CONCEPT QUESTIONS

- 13.8a** If an investment has a positive NPV, would it plot above or below the SML? Why?
- 13.8b** What is meant by the term cost of capital?

SUMMARY AND CONCLUSIONS**13.9**

This chapter has covered the essentials of risk. Along the way, we have introduced a number of definitions and concepts. The most important of these is the security market line, or SML. The SML is important because it tells us the reward offered in financial markets for bearing risk. Once we know this, we have a benchmark against which we compare the returns expected from real asset investments to determine if they are desirable.

Because we have covered quite a bit of ground, it's useful to summarize the basic economic logic underlying the SML as follows:

1. Based on capital market history, there is a reward for bearing risk. This reward is the risk premium on an asset.
2. The total risk associated with an asset has two parts: systematic risk and unsystematic risk. Unsystematic risk can be freely eliminated by diversification (this is the principle of diversification), so only systematic risk is rewarded. As a result, the risk premium on an asset is determined by its systematic risk. This is the systematic risk principle.
3. An asset's systematic risk, relative to the average, can be measured by its beta coefficient, β_i . The risk premium on an asset is then given by its beta coefficient multiplied by the market risk premium, $[E(R_M) - R_f] \times \beta_i$.
4. The expected return on an asset, $E(R_i)$, is equal to the risk-free rate, R_f , plus the risk premium:

$$E(R_i) = R_f + [E(R_M) - R_f] \times \beta_i$$

This is the equation of the SML, and it is often called the capital asset pricing model (CAPM).

This chapter completes our discussion of risk and return. Now that we have a better understanding of what determines a firm's cost of capital for an investment, the next several chapters will examine more closely how firms raise the long-term capital needed for investment.

Chapter Review and Self-Test Problems

- 13.1 Expected Return and Standard Deviation** This problem will give you some practice calculating measures of prospective portfolio performance. There are two assets and three states of the economy:



State of Economy	Probability of State of Economy	Rate of Return if State Occurs	
		Stock A	Stock B
Recession	.20	-.15	.20
Normal	.50	.20	.30
Boom	.30	.60	.40

What are the expected returns and standard deviations for these two stocks?

- 13.2 Portfolio Risk and Return** Using the information in the previous problem, suppose you have \$20,000 total. If you put \$15,000 in Stock A and the remainder in Stock B, what will be the expected return and standard deviation of your portfolio?
- 13.3 Risk and Return** Suppose you observe the following situation:

Security	Beta	Expected Return
Cooley, Inc.	1.8	22.00%
Moyer Co.	1.6	20.44%

If the risk-free rate is 7 percent, are these securities correctly priced? What would the risk-free rate have to be if they are correctly priced?

- 13.4 CAPM** Suppose the risk-free rate is 8 percent. The expected return on the market is 16 percent. If a particular stock has a beta of .7, what is its expected return based on the CAPM? If another stock has an expected return of 24 percent, what must its beta be?

Answers to Chapter Review and Self-Test Problems

- 13.1** The expected returns are just the possible returns multiplied by the associated probabilities:

$$E(R_A) = (.20 \times -.15) + (.50 \times .20) + (.30 \times .60) = 25\%$$

$$E(R_B) = (.20 \times .20) + (.50 \times .30) + (.30 \times .40) = 31\%$$

The variances are given by the sums of the squared deviations from the expected returns multiplied by their probabilities:

$$\begin{aligned}\sigma_A^2 &= .20 \times (-.15 - .25)^2 + .50 \times (.20 - .25)^2 + .30 \times (.60 - .25)^2 \\ &= (.20 \times -.40^2) + (.50 \times -.05^2) + (.30 \times .25^2) \\ &= (.20 \times .16) + (.50 \times .0025) + (.30 \times .1225) \\ &= .0700\end{aligned}$$

$$\begin{aligned}\sigma_B^2 &= .20 \times (.20 - .31)^2 + .50 \times (.30 - .31)^2 + .30 \times (.40 - .31)^2 \\ &= (.20 \times .11^2) + (.50 \times -.01^2) + (.30 \times .09^2) \\ &= (.20 \times .0121) + (.50 \times .0001) + (.30 \times .0081) \\ &= .0049\end{aligned}$$

The standard deviations are thus:

$$\sigma_A = \sqrt{.0700} = 26.46\%$$

$$\sigma_B = \sqrt{.0049} = 7\%$$

- 13.2** The portfolio weights are $\$15,000/20,000 = .75$ and $\$5,000/20,000 = .25$. The expected return is thus:

$$\begin{aligned} E(R_p) &= .75 \times E(R_A) + .25 \times E(R_B) \\ &= (.75 \times 25\%) + (.25 \times 31\%) \\ &= 26.5\% \end{aligned}$$

Alternatively, we could calculate the portfolio's return in each of the states:

State of Economy	Probability of State of Economy	Portfolio Return if State Occurs
Recession	.20	$(.75 \times -.15) + (.25 \times .20) = -.0625$
Normal	.50	$(.75 \times .20) + (.25 \times .30) = .2250$
Boom	.30	$(.75 \times .60) + (.25 \times .40) = .5500$

The portfolio's expected return is:

$$E(R_p) = (.20 \times -.0625) + (.50 \times .2250) + (.30 \times .5500) = 26.5\%$$

This is the same as we had before.

The portfolio's variance is:

$$\begin{aligned} \sigma_p^2 &= .20 \times (-.0625 - .265)^2 + .50 \times (.225 - .265)^2 \\ &\quad + .30 \times (.55 - .265)^2 \\ &= 0.0466 \end{aligned}$$

So the standard deviation is $\sqrt{.0466} = 21.59\%$.

- 13.3** If we compute the reward-to-risk ratios, we get $(22\% - 7\%)/1.8 = 8.33\%$ for Cooley versus 8.4% for Moyer. Relative to that of Cooley, Moyer's expected return is too high, so its price is too low.

If they are correctly priced, then they must offer the same reward-to-risk ratio. The risk-free rate would have to be such that:

$$(22\% - R_f)/1.8 = (20.44\% - R_f)/1.6$$

With a little algebra, we find that the risk-free rate must be 8 percent:

$$\begin{aligned} 22\% - R_f &= (20.44\% - R_f)(1.8/1.6) \\ 22\% - 20.44\% \times 1.125 &= R_f - R_f \times 1.125 \\ R_f &= 8\% \end{aligned}$$

- 13.4** Because the expected return on the market is 16 percent, the market risk premium is $16\% - 8\% = 8\%$. The first stock has a beta of .7, so its expected return is $8\% + .7 \times 8\% = 13.6\%$.

For the second stock, notice that the risk premium is $24\% - 8\% = 16\%$. Because this is twice as large as the market risk premium, the beta must be exactly equal to 2. We can verify this using the CAPM:

$$\begin{aligned} E(R_i) &= R_f + [E(R_M) - R_f] \times \beta_i \\ 24\% &= 8\% + (16\% - 8\%) \times \beta_i \\ \beta_i &= 16\%/8\% \\ &= 2.0 \end{aligned}$$

Concepts Review and Critical Thinking Questions

- 1. Diversifiable and Nondiversifiable Risks** In broad terms, why is some risk diversifiable? Why are some risks nondiversifiable? Does it follow that an investor can control the level of unsystematic risk in a portfolio, but not the level of systematic risk?
- 2. Information and Market Returns** Suppose the government announces that, based on a just-completed survey, the growth rate in the economy is likely to be 2 percent in the coming year, as compared to 5 percent for the year just completed. Will security prices increase, decrease, or stay the same following this announcement? Does it make any difference whether or not the 2 percent figure was anticipated by the market? Explain.
- 3. Systematic versus Unsystematic Risk** Classify the following events as mostly systematic or mostly unsystematic. Is the distinction clear in every case?
 - a.** Short-term interest rates increase unexpectedly.
 - b.** The interest rate a company pays on its short-term debt borrowing is increased by its bank.
 - c.** Oil prices unexpectedly decline.
 - d.** An oil tanker ruptures, creating a large oil spill.
 - e.** A manufacturer loses a multimillion-dollar product liability suit.
 - f.** A Supreme Court decision substantially broadens producer liability for injuries suffered by product users.
- 4. Systematic versus Unsystematic Risk** Indicate whether the following events might cause stocks in general to change price, and whether they might cause Big Widget Corp.'s stock to change price.
 - a.** The government announces that inflation unexpectedly jumped by 2 percent last month.
 - b.** Big Widget's quarterly earnings report, just issued, generally fell in line with analysts' expectations.
 - c.** The government reports that economic growth last year was at 3 percent, which generally agreed with most economists' forecasts.
 - d.** The directors of Big Widget die in a plane crash.
 - e.** Congress approves changes to the tax code that will increase the top marginal corporate tax rate. The legislation had been debated for the previous six months.
- 5. Expected Portfolio Returns** If a portfolio has a positive investment in every asset, can the expected return on the portfolio be greater than that on every asset in the portfolio? Can it be less than that on every asset in the portfolio? If you answer yes to one or both of these questions, give an example to support your answer.
- 6. Diversification** True or false: The most important characteristic in determining the expected return of a well-diversified portfolio is the variances of the individual assets in the portfolio. Explain.
- 7. Portfolio Risk** If a portfolio has a positive investment in every asset, can the standard deviation on the portfolio be less than that on every asset in the portfolio? What about the portfolio beta?
- 8. Beta and CAPM** Is it possible that a risky asset could have a beta of zero? Explain. Based on the CAPM, what is the expected return on such an asset? Is it possible that a risky asset could have a negative beta? What does the CAPM pre-

dict about the expected return on such an asset? Can you give an explanation for your answer?

9. **Corporate Downsizing** In recent years, it has been common for companies to experience significant stock price changes in reaction to announcements of massive layoffs. Critics charge that such events encourage companies to fire longtime employees and that Wall Street is cheering them on. Do you agree or disagree?
10. **Earnings and Stock Returns** As indicated by a number of examples in this chapter, earnings announcements by companies are closely followed by, and frequently result in, share price revisions. Two issues should come to mind. First, earnings announcements concern past periods. If the market values stocks based on expectations of the future, why are numbers summarizing past performance relevant? Second, these announcements concern accounting earnings. Going back to Chapter 2, such earnings may have little to do with cash flow, so, again, why are they relevant?

Questions and Problems

1. **Determining Portfolio Weights** What are the portfolio weights for a portfolio that has 90 shares of Stock A that sell for \$35 per share and 70 shares of Stock B that sell for \$25 per share? **Basic**
(Questions 1–20)
2. **Portfolio Expected Return** You own a portfolio that has \$700 invested in Stock A and \$2,400 invested in Stock B. If the expected returns on these stocks are 11 percent and 18 percent, respectively, what is the expected return on the portfolio?
3. **Portfolio Expected Return** You own a portfolio that is 50 percent invested in Stock X, 30 percent in Stock Y, and 20 percent in Stock Z. The expected returns on these three stocks are 10 percent, 18 percent, and 13 percent, respectively. What is the expected return on the portfolio?
4. **Portfolio Expected Return** You have \$10,000 to invest in a stock portfolio. Your choices are Stock X with an expected return of 15 percent and Stock Y with an expected return of 10 percent. If your goal is to create a portfolio with an expected return of 13.5 percent, how much money will you invest in Stock X? In Stock Y?
5. **Calculating Expected Return** Based on the following information, calculate the expected return.

State of Economy	Probability of State of Economy	Rate of Return if State Occurs
Recession	.30	−.02
Boom	.70	.34

6. **Calculating Expected Return** Based on the following information, calculate the expected return.

State of Economy	Probability of State of Economy	Rate of Return if State Occurs
Recession	.40	−.05
Normal	.50	.12
Boom	.10	.25

Basic*(continued)*

7. **Calculating Returns and Standard Deviations** Based on the following information, calculate the expected return and standard deviation for the two stocks.

State of Economy	Probability of State of Economy	Rate of Return if State Occurs	
		Stock A	Stock B
Recession	.20	.06	-.20
Normal	.60	.07	.13
Boom	.20	.11	.33

8. **Calculating Expected Returns** A portfolio is invested 20 percent in Stock G, 70 percent in Stock J, and 10 percent in Stock K. The expected returns on these stocks are 5 percent, 16 percent, and 35 percent, respectively. What is the portfolio's expected return? How do you interpret your answer?
9. **Returns and Standard Deviations** Consider the following information:

State of Economy	Probability of State of Economy	Rate of Return if State Occurs		
		Stock A	Stock B	Stock C
Boom	.60	.07	.15	.33
Bust	.40	.13	.03	-.06

- a. What is the expected return on an equally weighted portfolio of these three stocks?
- b. What is the variance of a portfolio invested 20 percent each in A and B, and 60 percent in C?
10. **Returns and Standard Deviations** Consider the following information:

State of Economy	Probability of State of Economy	Rate of Return if State Occurs		
		Stock A	Stock B	Stock C
Boom	.20	.30	.45	.33
Good	.40	.12	.10	.15
Poor	.30	.01	-.15	-.05
Bust	.10	-.06	-.30	-.09

- a. Your portfolio is invested 30 percent each in A and C, and 40 percent in B. What is the expected return of the portfolio?
- b. What is the variance of this portfolio? The standard deviation?
11. **Calculating Portfolio Betas** You own a stock portfolio invested 25 percent in Stock Q, 20 percent in Stock R, 15 percent in Stock S, and 40 percent in Stock T. The betas for these four stocks are .9, 1.4, 1.1, and 1.8, respectively. What is the portfolio beta?
12. **Calculating Portfolio Betas** You own a portfolio equally invested in a risk-free asset and two stocks. If one of the stocks has a beta of .8 and the total portfolio is equally as risky as the market, what must the beta be for the other stock in your portfolio?

- 13. Using CAPM** A stock has a beta of 1.5, the expected return on the market is 14 percent, and the risk-free rate is 5 percent. What must the expected return on this stock be?
- 14. Using CAPM** A stock has an expected return of 13 percent, the risk-free rate is 5 percent, and the market risk premium is 7 percent. What must the beta of this stock be?
- 15. Using CAPM** A stock has an expected return of 10 percent, its beta is .9, and the risk-free rate is 6 percent. What must the expected return on the market be?
- 16. Using CAPM** A stock has an expected return of 14 percent, a beta of 1.6, and the expected return on the market is 11 percent. What must the risk-free rate be?
- 17. Using CAPM** A stock has a beta of 1.1 and an expected return of 15 percent. A risk-free asset currently earns 5 percent.
- What is the expected return on a portfolio that is equally invested in the two assets?
 - If a portfolio of the two assets has a beta of .6, what are the portfolio weights?
 - If a portfolio of the two assets has an expected return of 9 percent, what is its beta?
 - If a portfolio of the two assets has a beta of 2.20, what are the portfolio weights? How do you interpret the weights for the two assets in this case? Explain.
- 18. Using the SML** Asset W has an expected return of 17 percent and a beta of 1.4. If the risk-free rate is 4 percent, complete the following table for portfolios of Asset W and a risk-free asset. Illustrate the relationship between portfolio expected return and portfolio beta by plotting the expected returns against the betas. What is the slope of the line that results?

Percentage of Portfolio in Asset W	Portfolio Expected Return	Portfolio Beta
0%		
25		
50		
75		
100		
125		
150		

- 19. Reward-to-Risk Ratios** Stock Y has a beta of 1.45 and an expected return of 17 percent. Stock Z has a beta of .85 and an expected return of 12 percent. If the risk-free rate is 6 percent and the market risk premium is 7.5 percent, are these stocks correctly priced?
- 20. Reward-to-Risk Ratios** In the previous problem, what would the risk-free rate have to be for the two stocks to be correctly priced?
- 21. Portfolio Returns** Using information from the previous chapter on capital market history, determine the return on a portfolio that is equally invested in large-company stocks and long-term government bonds. What is the return on a portfolio that is equally invested in small-company stocks and Treasury bills?
- 22. CAPM** Using the CAPM, show that the ratio of the risk premiums on two assets is equal to the ratio of their betas.

Basic
(continued)

Intermediate
(Questions 21–27)

Intermediate

(continued)

23. **Portfolio Returns and Deviations** Consider the following information on three stocks:

State of Economy	Probability of State of Economy	Rate of Return if State Occurs		
		Stock A	Stock B	Stock C
Boom	.2	.20	.35	.60
Normal	.5	.15	.12	.05
Bust	.3	.01	-.25	-.50

- a. If your portfolio is invested 40 percent each in A and B and 20 percent in C, what is the portfolio expected return? The variance? The standard deviation?
- b. If the expected T-bill rate is 3.80 percent, what is the expected risk premium on the portfolio?
- c. If the expected inflation rate is 3.50 percent, what are the approximate and exact expected real returns on the portfolio? What are the approximate and exact expected real risk premiums on the portfolio?
24. **Analyzing a Portfolio** You want to create a portfolio equally as risky as the market, and you have \$1,000,000 to invest. Given this information, fill in the rest of the following table:

Asset	Investment	Beta
Stock A	\$200,000	.70
Stock B	\$250,000	1.10
Stock C		1.60
Risk-free asset		

25. **Analyzing a Portfolio** You have \$100,000 to invest in a portfolio containing Stock X, Stock Y, and a risk-free asset. You must invest all of your money. Your goal is to create a portfolio that has an expected return of 12.5 percent and that has only 80 percent of the risk of the overall market. If X has an expected return of 28 percent and a beta of 1.6, Y has an expected return of 16 percent and a beta of 1.2, and the risk-free rate is 7 percent, how much money will you invest in Stock X? How do you interpret your answer?
26. **Systematic versus Unsystematic Risk** Consider the following information on Stocks I and II:

State of Economy	Probability of State of Economy	Rate of Return if State Occurs	
		Stock I	Stock II
Recession	.20	.09	-.30
Normal	.60	.42	.12
Irrational exuberance	.20	.26	.44

The market risk premium is 10 percent, and the risk-free rate is 4 percent. Which stock has the most systematic risk? Which one has the most unsystematic risk? Which stock is “riskier”? Explain.

27. **SML** Suppose you observe the following situation:

Security	Beta	Expected Return
Pete Corp.	1.3	.20
Repete Co.	.8	.14

Assume these securities are correctly priced. Based on the CAPM, what is the expected return on the market? What is the risk-free rate?

Intermediate

(continued)

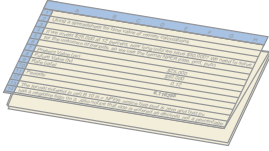
1. **Using CAPM** You can find estimates of beta for each company under the “Mthly. Val. Data” link. Locate the beta for AOL Time-Warner (AOL) and Dow Chemical (DOW). How has the beta for each of these companies changed over the period reported? Using the historical risk-free rate and market risk premium found in the chapter, calculate the expected return for each company based on the most recent beta. Is the expected return for each company what you would expect? Why or why not?
- 13.1 **Expected Return** You want to find the expected return for Honeywell using the CAPM. First you need the market risk premium. Go to www.cnnfn.com, follow the “Bonds & Rates” link, and the “Latest Rates” link. Find the current interest rate for three-month Treasury bills. Use the average large-company stock return in Table 12.3 to calculate the market risk premium. Next, go to finance.yahoo.com, enter the ticker symbol HON for Honeywell, and follow the “Profile” link. In the Statistics at a Glance section you will find the beta for Honeywell. What is the expected return for Honeywell using CAPM? What assumptions have you made to arrive at this number?
- 13.2 **Portfolio Beta** You have decided to invest in an equally weighted portfolio consisting of American Express, Procter & Gamble, Home Depot, and DuPont and need to find the beta of your portfolio. Go to finance.yahoo.com and follow the “Global Symbol Lookup” link to find the ticker symbols for each of these companies. Next, go back to finance.yahoo.com, enter one of the ticker symbols and get a stock quote. Follow the “Profile” link to find the beta for this company. You will then need to find the beta for each of the companies. What is the beta for your portfolio?
- 13.3 **Beta** Which companies currently have the highest and lowest betas? Go to www.amex.com and follow the “Screening” link. Enter 0 as the maximum beta and enter search. How many stocks currently have a beta less than 0? What is the lowest beta? Go back to the stock screener and enter 3 as the minimum. How many stocks have a beta above 3? What stock has the highest beta?
- 13.4 **Security Market Line** Go to finance.yahoo.com and enter the ticker symbol IP for International Paper. Follow the “Profile” link to get the beta for the company. Next, follow the “Research” link to find the estimated price in 12 months according to market analysts. Using the current share price and the mean target price, compute the expected return for this stock. Don’t forget to include the expected

S&P Problems

STANDARD & POOR’S

**What’s On
the Web?**

dividend payments over the next year. Now go to www.cnnfn.com, follow the “Bonds & Rates” link, the “Latest Rates” link and find the current interest rate for three-month Treasury bills. Using this information, calculate the expected return on the market using the reward-to-risk ratio. Does this number make sense? Why or why not?



Spreadsheet Templates 13–11, 13–17, 13–23, 13–24, 13–27