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.

3. **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.
4. **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.
5. **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?
6. **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 predict about the expected return on such an asset? Can you give an explanation for your answer?
7. **Covariance** Briefly explain why the covariance of a security with the rest of a well-diversified portfolio is a more appropriate measure of the risk of the security than the security's variance.
8. **Beta** Consider the following quotation from a leading investment manager: "The shares of Southern Co. have traded close to $12 for most of the past three years. Since Southern's stock has demonstrated very little price movement, the stock has a low beta. Texas Instruments, on the other hand, has traded as high as $150 and as low as its current $75. Since TI's stock has demonstrated a large amount of price movement, the stock has a very high beta." Do you agree with this analysis? Explain.
9. **Risk** A broker has advised you not to invest in oil industry stocks because they have high standard deviations. Is the broker's advice sound for a risk-averse investor like yourself? Why or why not?
10. **Security Selection** Is the following statement true or false? A risky security cannot have an expected return that is less than the risk-free rate because no risk-averse investor would be willing to hold this asset in equilibrium. Explain.

Questions and Problems

connect FINANCE

BASIC
(Questions 1–19)

1. **Determining Portfolio Weights** What are the portfolio weights for a portfolio that has 145 shares of Stock A that sell for $47 per share and 130 shares of Stock B that sell for $86 per share?
2. **Portfolio Expected Return** You own a portfolio that has $3,100 invested in Stock A and $4,600 invested in Stock B. If the expected returns on these stocks are 9.8 percent and 12.7 percent, respectively, what is the expected return on the portfolio?
3. **Portfolio Expected Return** You own a portfolio that is 20 percent invested in Stock X, 45 percent in Stock Y, and 35 percent in Stock Z. The expected returns on these three stocks are 10.5 percent, 16.1 percent, and 12.4 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 12.7 percent and Stock Y with an expected return of 9.1 percent. If your goal is to create a portfolio with an expected return of 11.2 percent, how much money will you invest in Stock X? In Stock Y?

5. **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	.25	.06	−.20
Normal	.55	.07	.13
Boom	.20	.11	.33

6. **Calculating Returns and Standard Deviations** Based on the following information, calculate the expected return and standard deviation:

State of Economy	Probability of State of Economy	Rate of Return if State Occurs
Depression	.15	−.148
Recession	.30	.031
Normal	.45	.162
Boom	.10	.348

7. **Calculating Expected Returns** A portfolio is invested 15 percent in Stock G, 60 percent in Stock J, and 25 percent in Stock K. The expected returns on these stocks are 9 percent, 11 percent, and 14 percent, respectively. What is the portfolio's expected return? How do you interpret your answer?

8. **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	.75	.06	.16	.33
Bust	.25	.14	.02	−.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?

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	.20	.24	.45	.33
Good	.35	.09	.10	.15
Poor	.40	.03	−.10	−.05
Bust	.05	−.05	−.25	−.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?

10. **Calculating Portfolio Betas** You own a stock portfolio invested 20 percent in Stock Q, 30 percent in Stock R, 15 percent in Stock S, and 35 percent in Stock T. The betas for these four stocks are .75, 1.90, 1.38, and 1.16, respectively. What is the portfolio beta?

11. **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 1.61 and the total portfolio is equally as risky as the market, what must the beta be for the other stock in your portfolio?

12. **Using CAPM** A stock has a beta of 1.15, the expected return on the market is 11.1 percent, and the risk-free rate is 3.8 percent. What must the expected return on this stock be?

13. **Using CAPM** A stock has an expected return of 10.4 percent, the risk-free rate is 3.8 percent, and the market risk premium is 7 percent. What must the beta of this stock be?

14. **Using CAPM** A stock has an expected return of 12.7 percent, its beta is 1.20, and the risk-free rate is 4.2 percent. What must the expected return on the market be?

15. **Using CAPM** A stock has an expected return of 10.9 percent, its beta is .9, and the expected return on the market is 11.8 percent. What must the risk-free rate be?

16. **Using CAPM** A stock has a beta of 1.08 and an expected return of 11.6 percent. A risk-free asset currently earns 3.6 percent.
    - **a.** What is the expected return on a portfolio that is equally invested in the two assets?
    - **b.** If a portfolio of the two assets has a beta of .50, what are the portfolio weights?
    - **c.** If a portfolio of the two assets has an expected return of 10.5 percent, what is its beta?
    - **d.** If a portfolio of the two assets has a beta of 2.16, what are the portfolio weights? How do you interpret the weights for the two assets in this case? Explain.

17. **Using the SML** Asset W has an expected return of 12.3 percent and a beta of 1.2. 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		

18. **Reward-to-Risk Ratios** Stock Y has a beta of 1.15 and an expected return of 11.8 percent. Stock Z has a beta of .85 and an expected return of 10.7 percent. If the risk-free rate is 4.5 percent and the market risk premium is 7.1 percent, are these stocks correctly priced?

19. **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?

INTERMEDIATE
(Questions 20–32)

20. **Portfolio Returns** Using information from the previous chapter about 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?

21. **CAPM** Using the CAPM, show that the ratio of the risk premiums on two assets is equal to the ratio of their betas.

2. The expected return of a portfolio is the sum of the weight of each asset times the expected return of each asset. The total value of the portfolio is:

Total value = $3,100 + 4,600
Total value = $7,700

So, the expected return of this portfolio is:

$\text{E}(R_\text{p}) = (\$3,100/\$7,700)(.098) + (\$4,600/\$7,700)(.127)$
$\text{E}(R_\text{p}) = .1153$, or 11.53%

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

$\text{E}(R_\text{p}) = .20(.105) + .45(.161) + .35(.124)$
$\text{E}(R_\text{p}) = .1369$, or 13.69%

4. Here we are given the expected return of the portfolio and the expected return of each asset in the portfolio and are asked to find the weight of each asset. We can use the equation for the expected return of a portfolio to solve this problem. Since the total weight of a portfolio must equal 1 (100%), the weight of Stock Y must be one minus the weight of Stock X. Mathematically speaking, this means:

$\text{E}(R_\text{p}) = .112 = .127X_\text{X} + .091(1 - X_\text{X})$

We can now solve this equation for the weight of Stock X as:

$.112 = .127X_\text{X} + .091 - .091X_\text{X}$
$.021 = .036X_\text{X}$
$X_\text{X} = .5833$

So, the dollar amount invested in Stock X is the weight of Stock X times the total portfolio value, or:

Investment in X = .5833($10,000)
Investment in X = $5,833.33

And the dollar amount invested in Stock Y is:

Investment in Y = (1 – .5833)($10,000)
Investment in Y = $4,166.67

5. The expected return of an asset is the sum of the probability of each state occurring times the rate of return if that state occurs. So, the expected return of each stock asset is:

$E(R_A) = .25(.06) + .55(.07) + .20(.11)$
$E(R_A) = .0755$, or 7.55%

$E(R_B) = .25(-.20) + .55(.13) + .20(.33)$
$E(R_B) = .0875$, or 8.75%

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

$\sigma_A^2 = .25(.06 - .0755)^2 + .55(.07 - .0755)^2 + .20(.11 - .0755)^2$
$\sigma_A^2 = .00031$

$\sigma_A = .00031^{1/2}$
$\sigma_A = .0177$, or 1.77%

$\sigma_B^2 = .25(-.20 - .0875)^2 + .55(.13 - .0875)^2 + .20(.33 - .0875)^2$
$\sigma_B^2 = .03342$

$\sigma_B = .03342^{1/2}$
$\sigma_B = .1828$, or 18.28%

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

$E(R_A) = .15(-.148) + .30(.031) + .45(.162) + .10(.348)$
$E(R_A) = .0948$, or 9.48%

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

$\sigma^2 = .15(-.148 - .0948)^2 + .30(.031 - .0948)^2 + .45(.162 - .0948)^2 + .10(.348 - .0948)^2$
$\sigma^2 = .01851$

$\sigma = .01851^{1/2}$
$\sigma = .1360$, or 13.60%

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

$E(R_p) = .15(.09) + .60(.11) + .25(.14)$
$E(R_p) = .1145$, or 11.45%

If we own this portfolio, we would expect to earn a return of 11.45 percent.

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

Boom: $R_p = (.06 + .16 + .33)/3$
$R_p = .1833$, or 18.33%

Bust: $R_p = (.14 + .02 - .06)/3$
$R_p = .0333$, or 3.33%

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

$E(R_p) = .75(.1833) + .25(.0333)$
$E(R_p) = .1458$, or 14.58%

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

Boom: $R_p = .20(.06) + .20(.16) + .60(.33)$
$R_p = .2420$, or 24.20%

Bust: $R_p = .20(.14) + .20(.02) + .60(-.06)$
$R_p = -.0040$, or $-.40\%$

And the expected return of the portfolio is:

$E(R_p) = .75(.2420) + .25(-.0040)$
$E(R_p) = .1805$, or 18.05%

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

$\sigma_p^2 = .75(.2420 - .1805)^2 + .25(-.0040 - .1805)^2$
$\sigma_p^2 = .011347$

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

Boom: $R_p = .30(.24) + .40(.45) + .30(.33)$
$R_p = .3510$, or 35.10%

Good: $R_p = .30(.09) + .40(.10) + .30(.15)$
$R_p = .1120$, or 11.20%

Poor: $R_p = .30(.03) + .40(-.10) + .30(-.05)$
$R_p = -.0460$, or –4.60%

Bust: $R_p = .30(-.05) + .40(-.25) + .30(-.09)$
$R_p = -.1420$, or –14.20%

And the expected return of the portfolio is:

$E(R_p) = .20(.3510) + .35(.1120) + .40(-.0460) + .05(-.1420)$
$E(R_p) = .0839$, or 8.39%

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

$\sigma_p^2 = .20(.3510 - .0839)^2 + .35(.1120 - .0839)^2 + .40(-.0460 - .0839)^2 + .05(-.1420 - .0839)^2$
$\sigma_p^2 = .02385$

$\sigma_p = .02385^{1/2}$
$\sigma_p = .1544$, or 15.44%

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

$\beta_p = .20(.75) + .30(1.90) + .15(1.38) + .35(1.16)$
$\beta_p = 1.33$

11. The beta of a portfolio is the sum of the weight of each asset times the beta of each asset. If the portfolio is as risky as the market it must have the same beta as the market. Since the beta of the market is 1.0, we know the beta of our portfolio is 1.0. We also need to remember that the beta of the risk-free asset is zero. It has to be zero since the asset has no risk. Setting up the equation for the beta of our portfolio, we get:

$\beta_p = 1.0 = {}^1/_3(0) + {}^1/_3(1.61) + {}^1/_3(\beta_X)$

Solving for the beta of Stock X, we get:

$\beta_X = 1.39$

12. CAPM states the relationship between the risk of an asset and its expected return. CAPM is:

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

Substituting the values we are given, we find:

$E(R_i) = .038 + (.111 - .038)(1.15)$
$E(R_i) = .1220$, or 12.20%

13. We are given the values for the CAPM except for the β of the stock. We need to substitute these values into the CAPM, and solve for the β of the stock. One important thing we need to realize is that we are given the market risk premium. The market risk premium is the expected return of the market minus the risk-free rate. We must be careful not to use this value as the expected return of the market. Using the CAPM, we find:

$E(R_i) = .104 = .038 + .07\beta_i$

$\beta_i = .94$

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

$E(R_i) = .127 = .042 + [E(R_M) - .042](1.20)$

$E(R_M) = .1128$, or 11.28%

15. Here we need to find the risk-free rate using the CAPM. Substituting the values given, and solving for the risk-free rate, we find:

$E(R_i) = .109 = R_f + (.118 - R_f)(.90)$
$.109 = R_f + .1062 - .90R_f$
$R_f = .0280$, or 2.80%

16. *a.* We have a special case where the portfolio is equally weighted, so we can sum the returns of each asset and divide by the number of assets. The expected return of the portfolio is:

$E(R_p) = (.116 + .036)/2$
$E(R_p) = .0760$, or 7.60%

b. We need to find the portfolio weights that result in a portfolio with a β of .50. We know the β of the risk-free asset is zero. We also know the weight of the risk-free asset is one minus the weight of the stock since the portfolio weights must sum to one, or 100 percent. So:

$\beta_p = .50 = X_S(1.08) + (1 - X_S)(0)$
$.50 = 1.08X_S + 0 - 0X_S$
$X_S = .50/1.08$
$X_S = .4630$

And, the weight of the risk-free asset is:

$X_{Rf} = 1 - .4630$
$X_{Rf} = .5370$

c. We need to find the portfolio weights that result in a portfolio with an expected return of 10 percent. We also know the weight of the risk-free asset is one minus the weight of the stock since the portfolio weights must sum to one, or 100 percent. So:

$E(R_p) = .105 = .116X_S + .036(1 - X_S)$
$.105 = .116X_S + .036 - .036X_S$
$X_S = .8625$

So, the β of the portfolio will be:

$\beta_p = .8625(1.08) + (1 - .8625)(0)$
$\beta_p = .932$

d. Solving for the β of the portfolio as we did in part *b*, we find:

$\beta_p = 2.16 = X_S(1.08) + (1 - X_S)(0)$
$X_S = 2.16/1.08$
$X_S = 2$

$X_{Rf} = 1 - 2$
$X_{Rf} = -1$

The portfolio is invested 200% in the stock and –100% in the risk-free asset. This represents borrowing at the risk-free rate to buy more of the stock.

17. First, we need to find the β of the portfolio. The β of the risk-free asset is zero, and the weight of the risk-free asset is one minus the weight of the stock, so the β of the portfolio is:

$\beta_p = X_W(1.2) + (1 - X_W)(0) = 1.2X_W$

So, to find the β of the portfolio for any weight of the stock, we multiply the weight of the stock times its β.

Even though we are solving for the β and expected return of a portfolio of one stock and the risk-free asset for different portfolio weights, we are really solving for the SML. Any combination of this stock and the risk-free asset will fall on the SML. For that matter, a portfolio of any stock and the risk-free asset, or any portfolio of stocks, will fall on the SML. We know the slope of the SML line is the market risk premium, so using the CAPM and the information concerning this stock, the market risk premium is:

$E(R_W) = .123 = .04 + MRP(1.20)$
$MRP = .083/1.2$
$MRP = .0692$, or 6.92%

So, now we know the CAPM equation for any stock is:

$E(R_p) = .04 + .0692\beta_p$