E*8.6. Reconsider the portfolio selection example, including its spreadsheet model in Figure 8.13, given in Section 8.2. Note in Table 8.2 that Stock 2 has the highest expected return and stock 3 has by far the lowest. Nevertheless, the changing cells Portfolio (C14:E14) provide an optimal solution that calls for purchasing far more of Stock 3 than of Stock 2. Although purchasing so much of Stock 3 greatly reduces the risk of the portfolio, an aggressive investor may be unwilling to own so much of a stock with such a low expected return.

For the sake of such an investor, add a constraint to the model that specifies that the percentage of Stock 3 in the portfolio cannot exceed the amount specified by the investor. Then compare the expected return and risk (standard deviation of the return) of the optimal portfolio with that in Figure 8.13 when the upper bound on the percentage of Stock 3 allowed in the portfolio is set at the following values.

a. 20%

b. 0%

c. Generate a parameter analysis report using RSPE to systematically try all the percentages at 5% intervals from 0% to 50%.

8.7.* A stockbroker, Richard Smith, has just received a call from his most important client, Ann Hardy. Ann has $50,000 to invest and wants to use it to purchase two stocks. Stock 1 is a solid blue-chip security with a respectable growth potential and little risk involved. Stock 2 is much more speculative. It is being touted in two investment newsletters as having outstanding growth potential, but also is considered very risky. Ann would like a large return on her investment, but also has considerable aversion to risk. Therefore, she has instructed Richard to analyze what mix of investments in the two stocks would be appropriate for her. She also informs him that her plan is to hold the stock being purchased now for three years before selling it.

After doing some research on the historical performances of the two stocks and on the current prospects for the companies involved, Richard is able to make the following estimates. If the entire $50,000 were to be invested in Stock 1 now, the profit when sold in three years would have an expected value of $12,500 and a standard deviation of $5,000. If the entire $50,000 were to be invested in Stock 2 now, the profit when sold in three years would have an expected value of $20,000 and a standard deviation of $30,000. The two stocks behave independently in different sectors of the market so Richard's calculation from historical data is that the covariance of the profits from the two stocks is 0.

Richard now is ready to use a spreadsheet model to determine how to allocate the $50,000 to the two stocks so as to minimize Ann's risk while providing an expected profit that is at least as large as her minimum acceptable value. He asks Ann to decide what her minimum acceptable value is.

a. Without yet assigning a specific numerical value to the minimum acceptable expected profit, formulate a quadratic programming model in algebraic form for this problem.

E* *b.* Display this model on a spreadsheet.

E* *c.* Solve this model for four cases: Minimum acceptable expected profit = $13,000, $15,000, $17,000, and $19,000.

d. Ann was a statistics major in college and so understands well that the *expected return* and *risk* in this model represent estimates of the *mean* and *standard deviation* of the probability distribution of the profit from the corresponding portfolio. Ann uses the notation μ and σ for the mean and standard deviation. She recalls that, for typical probability distributions, the probability is fairly high (about 0.8 or 0.9) that the return will exceed $\mu - \sigma$, and the probability is extremely high (often close to 0.999) that the profit will exceed $\mu - 3\sigma$. Calculate $\mu - \sigma$ and $\mu - 3\sigma$ for the four portfolios obtained in part *c*. Which portfolio will give Ann the highest μ among those that also give $\mu - \sigma \geq 0$?

8.8. Reconsider the portfolio selection example given in Section 8.2. A fourth stock (Stock 4) now has been found that gives a good balance between expected return and risk. Using the same units as in Table 8.2, its expected return is 17% and its risk is 18%. Its joint risk per stock with Stocks 1, 2, and 3 is −0.015, −0.025, and 0.003, respectively.

a. Still using a minimum acceptable expected return of 18%, formulate the revised quadratic programming model in algebraic form for this problem.

E* *b.* Display and solve this model on a spreadsheet.

E* *c.* Develop a revision of the parameter analysis report in Figure 8.14 for this revised problem.

8.9. The management of the Albert Hanson Company is trying to determine the best product mix for two new products. Because these products would share the same production facilities, the total number of units produced of the two products combined cannot exceed two per hour. Because of uncertainty about how well these products will sell, the profit from producing each product provides decreasing marginal returns as the production rate is increased. In particular, with a production rate of R_1 units per hour, it is estimated that Product 1 would provide a profit per hour of $\$200R_1 - \$100R_1^2$. If the production rate of product 2 is R_2 units per hour, its estimated profit per hour would be $\$300R_2 - \$100R_2^2$.

a. Formulate a quadratic programming model in algebraic form for determining the product mix that maximizes the total profit per hour.

E* *b.* Formulate this model on a spreadsheet.

c. Use RSPE's Analyze without Solving feature to confirm that the model is QP Convex.

d. Solve the model using the appropriate solving method.

8.10. The B. J. Jensen Company specializes in the production of power saws and power drills for home use. Sales are relatively stable throughout the year except for a jump upward during the Christmas season. Since the production work requires considerable work and experience, the company maintains a stable employment level and then uses overtime to increase production in November. The workers also welcome this opportunity to earn extra money for the holidays.

B. J. Jensen, Jr., the current president of the company, is overseeing the production plans being made for the upcoming November. He has obtained the data at the top of the next page.

However, Mr. Jensen now has learned that, in addition to the limited number of labor hours available, two other factors will limit the production levels that can be achieved this November. One is that the company's vendor for power supply units will only be able to provide 10,000 of these units for November (2,000 more than his usual monthly shipment). Each power saw and each power drill requires one of these units. Second, the