10. A retail store in Des Moines, Iowa, receives shipments of a particular product from Kansas City and Minneapolis. Let

$$x = \text{number of units of the product received from Kansas City}$$
$$y = \text{number of units of the product received from Minneapolis}$$

   a. Write an expression for the total number of units of the product received by the retail store in Des Moines.

   b. Shipments from Kansas City cost $0.20 per unit, and shipments from Minneapolis cost $0.25 per unit. Develop an objective function representing the total cost of shipments to Des Moines.

   c. Assuming the monthly demand at the retail store is 5000 units, develop a constraint that requires 5000 units to be shipped to Des Moines.

   d. No more than 4000 units can be shipped from Kansas City, and no more than 3000 units can be shipped from Minneapolis in a month. Develop constraints to model this situation.

   e. Of course, negative amounts cannot be shipped. Combine the objective function and constraints developed to state a mathematical model for satisfying the demand at the Des Moines retail store at minimum cost.

11. For most products, higher prices result in a decreased demand, whereas lower prices result in an increased demand. Let

$$d = \text{annual demand for a product in units}$$
$$p = \text{price per unit}$$

Assume that a firm accepts the following price-demand relationship as being realistic:

$$d = 800 - 10p$$

where p must be between $20 and $70.

   a. How many units can the firm sell at the $20 per-unit price? At the $70 per-unit price?

   b. Show the mathematical model for the total revenue (TR), which is the annual demand multiplied by the unit price.

   c. Based on other considerations, the firm's management will only consider price alternatives of $30, $40, and $50. Use your model from part (b) to determine the price alternative that will maximize the total revenue.

   d. What are the expected annual demand and the total revenue corresponding to your recommended price?

SELF test

12. The O'Neill Shoe Manufacturing Company will produce a special-style shoe if the order size is large enough to provide a reasonable profit. For each special-style order, the company incurs a fixed cost of $1000 for the production setup. The variable cost is $30 per pair, and each pair sells for $40.

   a. Let x indicate the number of pairs of shoes produced. Develop a mathematical model for the total cost of producing x pairs of shoes.

   b. Let P indicate the total profit. Develop a mathematical model for the total profit realized from an order for x pairs of shoes.

   c. How large must the shoe order be before O'Neill will break even?

13. Micromedia offers computer training seminars on a variety of topics. In the seminars each student works at a personal computer, practicing the particular activity that the instructor is presenting. Micromedia is currently planning a two-day seminar on the use of Microsoft Excel in statistical analysis. The projected fee for the seminar is $300 per student. The cost for the conference room, instructor compensation, lab assistants, and promotion is $4,800. Micromedia rents computers for its seminars at a cost of $30 per computer per day.

   a. Develop a model for the total cost to put on the seminar. Let x represent the number of students who enroll in the seminar.

   b. Develop a model for the total profit if x students enroll in the seminar.

   c. Micromedia has forecasted an enrollment of 30 students for the seminar. How much profit will be earned if their forecast is accurate?

   d. Compute the breakeven point.

14. Eastman Publishing Company is considering publishing a paperback textbook on spreadsheet applications for business. The fixed cost of manuscript preparation, textbook design, and production setup is estimated to be $80,000. Variable production and material costs are estimated to be $3 per book. Demand over the life of the book is estimated to be 4000 copies. The publisher plans to sell the text to college and university bookstores for $20 each.

    a. What is the breakeven point?

    b. What profit or loss can be anticipated with a demand of 4000 copies?

    c. With a demand of 4000 copies, what is the minimum price per copy that the publisher must charge to break even?

    d. If the publisher believes that the price per copy could be increased to $25.95 and not affect the anticipated demand of 4000 copies, what action would you recommend? What profit or loss can be anticipated?