a. a logical approach to decision making.
b. a rational approach to decision making.
c. a scientific approach to decision making.
d. all of the above.

3. Frederick Winslow Taylor
   a. was a military researcher during World War II.
   b. pioneered the principles of scientific management.
   c. developed the use of the algorithm for QA.
   d. all of the above.
4. An input (such as variable cost per unit or fixed cost) for a model is an example of
   a. a decision variable.
   b. a parameter.
   c. an algorithm.
   d. a stochastic variable.
5. The point at which the total revenue equals total cost (meaning zero profit) is called the
   a. zero-profit solution.
   b. optimal-profit solution.
   c. break-even point.
   d. fixed-cost solution.
6. Quantitative analysis is typically associated with the use of
   a. schematic models.
   b. physical models.
   c. mathematical models.
   d. scale models.
7. Sensitivity analysis is most often associated with which step of the quantitative analysis approach?
   a. defining the problem
   b. acquiring input data
   c. [illegible]
   d. there is no available computer software.
9. The term *algorithm*
   a. is named after Algorismus.
   b. is named after a ninth-century Arabic mathematician.
   c. describes a series of steps or procedures to be repeated.
   d. all of the above.
10. An analysis to determine how much a solution would change if there were changes in the model or the input data is called
    a. sensitivity or postoptimality analysis.
    b. schematic or iconic analysis.
    c. futurama conditioning.
    d. both b and c.
11. Decision variables are
    a. controllable.
    b. uncontrollable.
    c. parameters.
    d. constant numerical values associated with any complex problem.
12. _____ is the scientific approach to managerial decision making.
13. _____ is the first step in quantitative analysis.
14. A _____ is a picture, drawing, or chart of reality.
15. A series of steps that are repeated until a solution is found is called a(n) _____.

DISCUSSION QUESTIONS AND PROBLEMS

Discussion Questions

1-1 What is the difference between quantitative and qualitative analysis? Give several examples.

1-2 Define *quantitative analysis.* What are some of the organizations that support the use of the scientific approach?

1-3 What is the quantitative analysis process? Give several examples of this process.

1-4 Briefly trace the history of quantitative analysis. What happened to the development of quantitative analysis during World War II?

1-5 Give some examples of various types of models. What is a mathematical model? Develop two examples of mathematical models.

1-6 List some sources of input data.

1-7 What is implementation, and why is it important?

1-8 Describe the use of sensitivity analysis and postoptimality analysis in analyzing the results.

1-9 Managers are quick to claim that quantitative analysts talk to them in a jargon that does not sound like English. List four terms that might not be understood by a manager. Then explain in nontechnical terms what each term means.

1-10 Why do you think many quantitative analysts don't like to participate in the implementation process? What could be done to change this attitude?

1-11 Should people who will be using the results of a new quantitative model become involved in the technical aspects of the problem-solving procedure?

1-12 C. W. Churchman once said that "mathematics . . . tends to lull the unsuspecting into believing that he who thinks elaborately thinks well." Do you think that the best QA models are the ones that are most elaborate and complex mathematically? Why?

1-13 What is the break-even point? What parameters are necessary to find it?

Problems*

1-14 Gina Fox has started her own company, Foxy Shirts, which manufactures imprinted shirts for special occasions. Since she has just begun this operation, she rents the equipment from a local printing shop when necessary. The cost of using the equipment is $350. The materials used in one shirt cost $8, and Gina can sell these for $15 each.
(a) If Gina sells 20 shirts, what will her total revenue be? What will her total variable cost be?
(b) How many shirts must Gina sell to break even? What is the total revenue for this?

1-15 Ray Bond sells handcrafted yard decorations at county fairs. The variable cost to make these is $20 each, and he sells them for $50. The cost to rent a booth at the fair is $150. How many of these must Ray sell to break even?

1-16 Ray Bond, from Problem 1-15, is trying to find a new supplier that will reduce his variable cost of production to $15 per unit. If he was able to succeed in reducing this cost, what would the break-even point be?

1-17 Katherine D'Ann is planning to finance her college education by selling programs at the football games for State University. There is a fixed cost of $400 for printing these programs, and the variable cost is $3. There is also a $1,000 fee that is paid to the university for the right to sell these programs. If Katherine was able to sell programs for $5 each, how many would she have to sell in order to break even?

1-18 Katherine D'Ann, from Problem 1-17, has become concerned that sales may fall, as the team is on a terrible losing streak, and attendance has fallen off. In fact, Katherine believes that she will sell only 500 programs for the next game. If it was possible to raise the selling price of the program and still sell 500, what would the price have to be for Katherine to break even by selling 500?

1-19 Farris Billiard Supply sells all types of billiard equipment, and is considering manufacturing their own brand of pool cues. Mysti Farris, the production manager, is currently investigating the production of a standard house pool cue that should be very popular. Upon analyzing the costs, Mysti determines that the materials and labor cost for each cue is $25, and the fixed cost that must be covered is $2,400 per week. With a selling price of $40 each, how many pool cues must be sold to break even? What would the total revenue be at this break-even point?

1-20 Mysti Farris (see Problem 1-19) is considering raising the selling price of each cue to $50 instead of $40. If this is done while the costs remain the same, what would the new break-even point be? What would the total revenue be at this break-even point?

1-21 Mysti Farris (see Problem 1-19) believes that there is a high probability that 120 pool cues can be sold if the selling price is appropriately set. What selling price would cause the break-even point to be 120?

1-22 Golden Age Retirement Planners specializes in providing financial advice for people planning for a comfortable retirement. The company offers seminars on the important topic of retirement planning. For a typical seminar, the room rental at a hotel is $1,000, and the cost of advertising and other incidentals is about $10,000 per seminar. The cost of the materials and special gifts for each attendee is $60 per person attending the seminar. The company charges $250 per person to attend the seminar as this seems to be competitive with other companies in the same business. How many people must attend each seminar for Golden Age to break even?

CASE STUDY

Food and Beverages at Southwestern University Football Games

Southwestern University (SWU), a large state college in Stephenville, Texas, 30 miles southwest of the Dallas/Fort Worth metroplex, enrolls close to 20,000 students. The school is the dominant force in the small city, with more students during fall and spring than permanent residents.

A longtime football powerhouse, SWU is a member of the Big Eleven conference and is usually in the top 20 in college football rankings. To bolster its chances of reaching the elusive and long-desired number-one ranking, in 2002 SWU hired the legendary Bo Pitterno as its head coach. Although the number-one ranking remained out of reach, attendance at the five Saturday home games each year increased. Prior to Pitterno's arrival, attendance generally averaged 25,000–29,000. Season ticket sales bumped up by 10,000 just with the announcement of the new coach's arrival. Stephenville and SWU were ready to move to the big time!

With the growth in attendance came more fame, the need for a bigger stadium, and more complaints about seating, parking, long lines, and concession stand prices. Southwestern University's president, Dr. Marty Starr, was concerned not only

DISCUSSION QUESTIONS AND PROBLEMS

Discussion Questions

12-1 What is the minimal-spanning tree technique? What types of problems can be solved using this quantitative analysis technique?

12-2 Describe the steps of the maximal-flow technique.

12-3 Give several examples of problems that can be solved using the maximal-flow technique.

12-4 What are the steps of the shortest-route technique?

12-5 Describe a problem that can be solved by the shortest-route technique.

12-6 Is it possible to get alternate optimal solutions with the shortest-route technique? Is there an automatic way of knowing if you have an alternate optimal solution?

Problems*

12-7 Bechtold Construction is in the process of installing power lines to a large housing development. Steve Bechtold wants to minimize the total length of wire used, which will minimize his costs. The housing development is shown as a network in Figure 12.21. Each house has been numbered, and the distances between houses are given in hundreds of feet. What do you recommend?

12-8 The city of New Berlin is considering making several of its streets one-way. What is the maximum number of cars per hour that can travel from east to west? The network is shown in Figure 12.22.

12-9 Transworld Moving has been hired to move the office furniture and equipment of Cohen Properties to their new headquarters. What route do you recommend? The network of roads is shown in Figure 12.23.

12-10 Because of a sluggish economy, Bechtold Construction has been forced to modify its plans for the housing development in Problem 12-7. The result is that the path from node 6 to 7 now has a distance of 7. What impact does this have on the total length of wire needed to install the power lines?

12-11 Due to increased property taxes and an aggressive road development plan, the city of New Berlin has been able to increase the road capacity of two of its roads (see Problem 12-8). The capacity along the road

FIGURE 12.21

Network for Problem 12-7

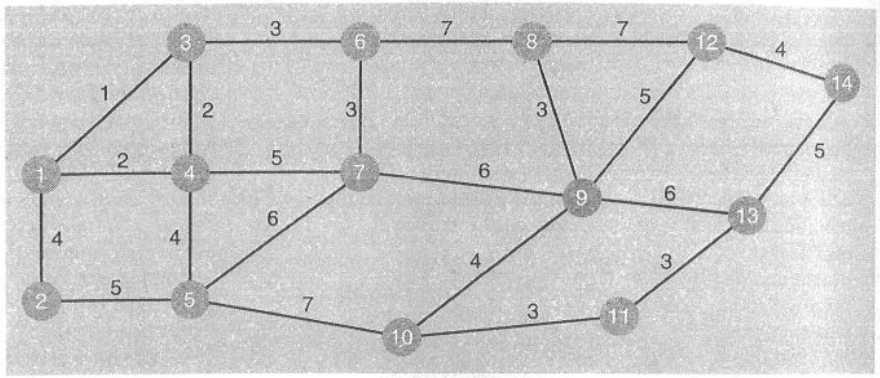

FIGURE 12.22

Network for Problem 12-8