



## Sheet 1-Chapter 1 PROBLEMS

### Introduction

1. Define the terms *management science* and *operations research*.
2. List and discuss the steps of the decision-making process.
4. A firm just completed a new plant that will produce more than 500 different products, using more than 50 different production lines and machines. The production scheduling decisions are critical in that sales will be lost if customer demands are not met on time. If no individual in the firm has experience with this production operation and if new production schedules must be generated each week, why should the firm consider a quantitative approach to the production scheduling problem?
6. Suppose that a manager has a choice between the following two mathematical models of a given situation: (a) a relatively simple model that is a reasonable approximation of the real situation, and (b) a thorough and complex model that is the most accurate mathematical representation of the real situation possible. Why might the model described in part (a) be preferred by the manager?
8. Recall the production model from Section 1.3:

$$\begin{array}{ll} \text{Max} & 10x \\ \text{s.t.} & \\ & 5x \leq 40 \\ & x \geq 0 \end{array}$$

Suppose the firm in this example considers a second product that has a unit profit of \$5 and requires 2 hours of production time for each unit produced. Use  $y$  as the number of units of product 2 produced.

- a. Show the mathematical model when both products are considered simultaneously.
  - b. Identify the controllable and uncontrollable inputs for this model.
  - c. Draw the flowchart of the input-output process for this model (see Figure 1.5).
  - d. What are the optimal solution values of  $x$  and  $y$ ?
  - e. Is the model developed in part (a) a deterministic or a stochastic model? Explain.
10. A retail store in Des Moines, Iowa, receives shipments of a particular product from Kansas City and Minneapolis. Let



- 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.
- 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 \$4800.
- 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.