Chapter 1
Introduction

Learning Objectives

1. Develop a general understanding of the management science/operations research approach to decision making.

2. Realize that quantitative applications begin with a problem situation.

3. Obtain a brief introduction to quantitative techniques and their frequency of use in practice.

4. Understand that managerial problem situations have both quantitative and qualitative considerations that are important in the decision making process.

5. Learn about models in terms of what they are and why they are useful (the emphasis is on mathematical models).

6. Identify the step-by-step procedure that is used in most quantitative approaches to decision making.

7. Learn about basic models of cost, revenue, and profit and be able to compute the breakeven point.

8. Obtain an introduction to the use of computer software packages such as *The Management Scientist* and *Microsoft Excel* in applying quantitative methods to decision making.

9. Understand the following terms:

model	infeasible solution
objective function	management science
constraint	operations research
deterministic model	fixed cost
stochastic model	variable cost
feasible solution	breakeven point

Solutions:

1. Management science and operations research, terms used almost interchangeably, are broad disciplines that employ scientific methodology in managerial decision making or problem solving. Drawing upon a variety of disciplines (behavioral, mathematical, etc.), management science and operations research combine quantitative and qualitative considerations in order to establish policies and decisions that are in the best interest of the organization.

2. Define the problem

   Identify the alternatives

   Determine the criteria

   Evaluate the alternatives

   Choose an alternative

   For further discussion see section 1.3

3. See section 1.2.

4. A quantitative approach should be considered because the problem is large, complex, important, new and repetitive.

5. Models usually have time, cost, and risk advantages over experimenting with actual situations.

6. Model (a) may be quicker to formulate, easier to solve, and/or more easily understood.

7. Let d = distance
   m = miles per gallon
   c = cost per gallon,

   $$\therefore \text{Total Cost} = \left(\frac{2d}{m}\right)c$$

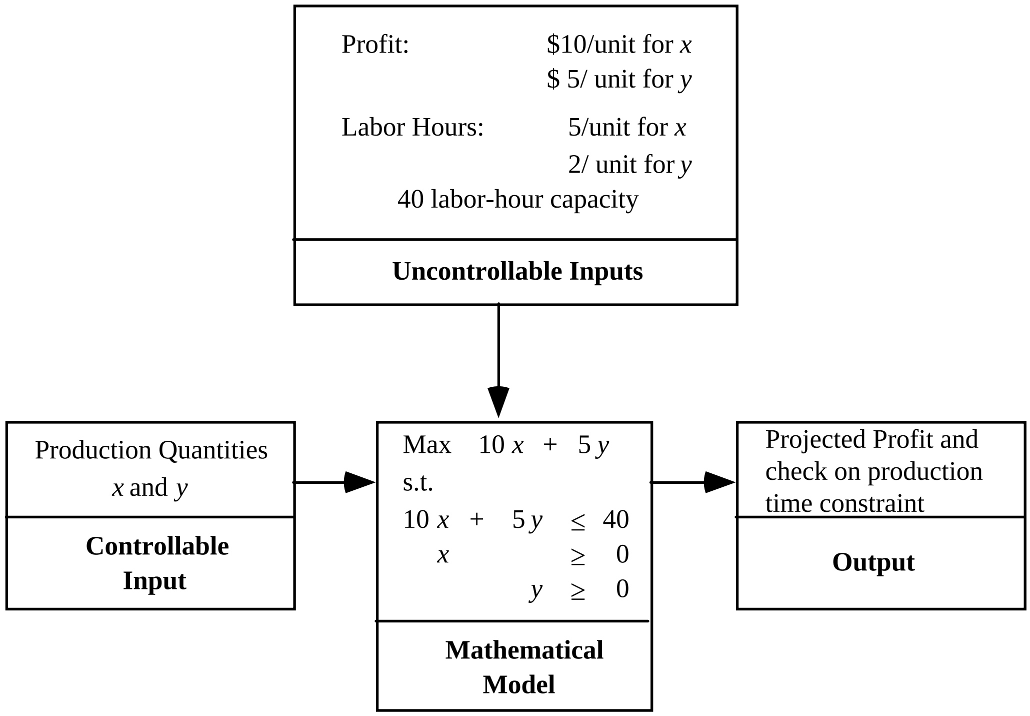
   We must be willing to treat m and c as known and not subject to variation.

8. a. Maximize $10x + 5y$
   s.t.

   $$5x + 2y \leq 40$$
   $$x \geq 0,\ y \geq 0$$

   b. Controllable inputs: x and y
   Uncontrollable inputs: profit (10,5), labor hours (5,2) and labor-hour availability (40)

c.



d. $x = 0$, $y = 20$ Profit = $100
(Solution by trial-and-error)

e. Deterministic - all uncontrollable inputs are fixed and known.

9. If $a = 3$, $x = 13\ 1/3$ and profit = 133
If $a = 4$, $x = 10$ and profit = 100
If $a = 5$, $x = 8$ and profit = 80
If $a = 6$, $x = 6\ 2/3$ and profit = 67

Since a is unknown, the actual values of x and profit are not known with certainty.

10. a. Total Units Received = $x + y$

b. Total Cost = $0.20x + 0.25y$

c. $x + y = 5000$

d. $x \le 4000$ Kansas City Constraint
$y \le 3000$ Minneapolis Constraint

e. Min $0.20x + 0.25y$
s.t.

$$\begin{aligned} x + y &= 5000 \\ x &\le 4000 \\ y &\le 3000 \\ x, y &\ge 0 \end{aligned}$$

11. a. at \$20 $d = 800 - 10(20) = 600$
at \$70 $d = 800 - 10(70) = 100$

b. $TR = dp = (800 - 10p)p = 800p - 10p^2$

c. at \$30 $TR = 800(30) - 10(30)^2 = 15{,}000$
at \$40 $TR = 800(40) - 10(40)^2 = 16{,}000$
at \$50 $TR = 800(50) - 10(50)^2 = 15{,}000$
Total Revenue is maximized at the \$40 price.

d. $d = 800 - 10(40) = 400$ units
$TR = \$16{,}000$

12. a. $TC = 1000 + 30x$

b. $P = 40x - (1000 + 30x) = 10x - 1000$

c. Breakeven point is the value of x when $P = 0$
Thus $10x - 1000 = 0$
$10x = 1000$
$x = 100$

13. a. Total cost = $4800 + 60x$

b. Total profit = total revenue - total cost
= $300x - (4800 + 60x)$
= $240x - 4800$

c. Total profit = $240(30) - 4800 = 2400$

d. $240x - 4800 = 0$

$x = 4800/240 = 20$

The breakeven point is 20 students.

14. a. Profit = Revenue - Cost
= $20x - (80{,}000 + 3x)$
= $17x - 80{,}000$

$17x - 80{,}000 = 0$
$17x = 80{,}000$
$x = 4706$

Breakeven point = 4706

b. Profit = $17(4000) - 80{,}000 = -12{,}000$

Thus, a loss of \$12,000 is anticipated.

c. Profit = $px - (80{,}000 + 3x)$
= $4000p - (80{,}000 + 3(4000)) = 0$
$4000p = 92{,}000$
$p = 23$

d. Profit $= \$25.95\ (4000) - (80{,}000 + 3\ (4000))$
$= \$11{,}800$

Probably go ahead with the project although the \$11,800 is only a 12.8% return on the total cost of \$92,000.

15. a. Profit $= 100{,}000x - (1{,}500{,}000 + 50{,}000x) = 0$

$$50{,}000x = 1{,}500{,}000$$
$$x = 30$$

b. Build the luxury boxes.

Profit $= 100{,}000\ (50) - (1{,}500{,}000 + 50{,}000\ (50))$
$= \$1{,}000{,}000$

16. a. Max $6x + 4y$

b.
$$50x + 30y \le 80{,}000$$
$$50x \le 50{,}000$$
$$30y \le 45{,}000$$
$$x, y \ge 0$$

17. a. $s_j = s_{j-1} + x_j - d_j$

or $s_j - s_{j-1} - x_j + d_j = 0$

b. $x_j \le c_j$

c. $s_j \ge I_j$