

**Introduction to Management Science
8th Edition
by
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**Chapter 1
Management Science**

Chapter Topics

- The Management Science Approach to Problem Solving
- Model Building: Break-Even Analysis
- Computer Solution
- Management Science Modeling Techniques
- Business Use of Management Science Techniques
- Management Science Models in Decision Support Systems

Management Science Approach

- Management science uses a scientific approach to solving management problems.
- It is used in a variety of organizations to solve many different types of problems.
- It encompasses a logical mathematical approach to problem solving.

Management Science Approach

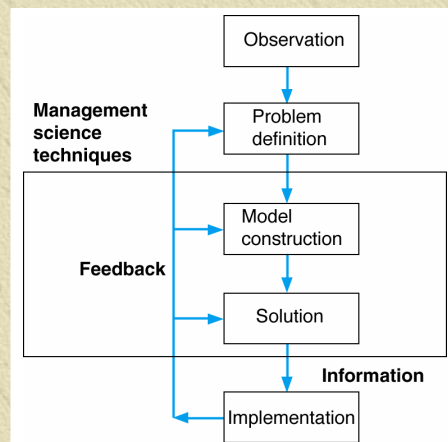


Figure 1.1
The Management Science Process

Steps in the Management Science Process

- ✚ **Observation** - Identification of a problem that exists in the system or organization.
- ✚ **Definition of the Problem** - problem must be clearly and consistently defined showing its boundaries and interaction with the objectives of the organization.
- ✚ **Model Construction** - Development of the functional mathematical relationships that describe the decision variables, objective function and constraints of the problem.
- ✚ **Model Solution** - Models solved using management science techniques.
- ✚ **Model Implementation** - Actual use of the model or its solution.

Problem Definition Example of Model Construction (1 of 2)

Information and Data:

- ✚ Business firm makes and sells a steel product
- ✚ Product costs \$5 to produce
- ✚ Product sells for \$20
- ✚ Product requires 4 pounds of steel to make
- ✚ Firm has 100 pounds of steel

Business Problem:

- ✚ Determine the number of units to produce to make the most profit given the limited amount of steel available.

Problem Definition

Example of Model Construction (2 of 2)

Variables: X = number of units (decision variable)
 Z = total profit

Model: $Z = \$20 \cdot X - \$5 \cdot X$ (objective function)
 $4 \cdot X = 100$ lb of steel (resource constraint)

Parameters: \$20, \$5, 4 lbs, 100 lbs (known values)

Formal Specification of Model:

maximize $Z = \$20 \cdot X - \$5 \cdot X$
subject to $4 \cdot X = 100$

Model Building

Break-Even Analysis (1 of 7)

- ✚ Used to determine the number of units of a product to sell or produce (i.e. volume) that will equate total revenue with total cost.
- ✚ The volume at which total revenue equals total cost is called the break-even point.
- ✚ Profit at break-even point is zero.

Model Building Break-Even Analysis (2 of 7)

Model Components

- ✚ **Fixed Costs (c_f)** - costs that remain constant regardless of number of units produced.
- ✚ **Variable Cost (c_v)** - unit cost of product.
- ✚ **Total variable cost (vc_v)** - function of volume (v) and variable per-unit cost.
- ✚ **Total Cost (TC)** - total fixed cost plus total variable cost.
- ✚ **Profit (Z)** - difference between total revenue vp (p = price) and total cost.

$$Z = v \cdot p - c_f - v \cdot c_v$$

Model Building Break-Even Analysis (3 of 7)

Computing the Break-Even Point

- ✚ The break-even point is that volume at which total revenue equals total cost and profit is zero:

$$V = c_f / (p - c_v)$$

Example: Western Clothing Company

$$c_f = \$10000$$

$$c_v = \$8 \text{ per pair}$$

$$p = \$23 \text{ per pair}$$

$$V = 666.7 \text{ pairs, break-even point}$$

Model Building Break-Even Analysis (4 of 7)

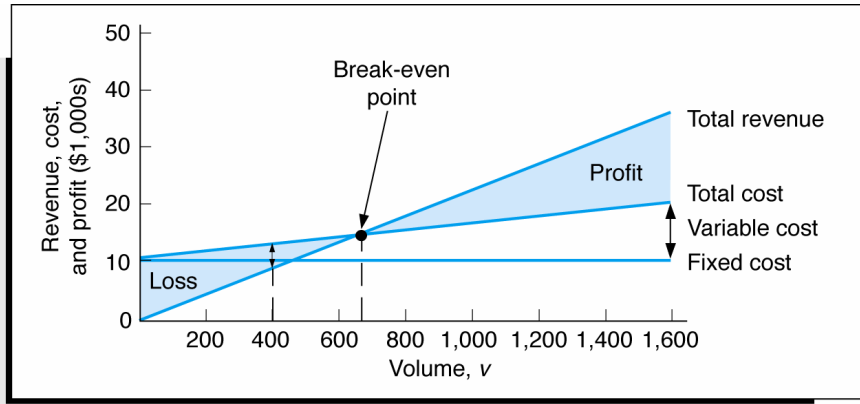


Figure 1.2
Break-Even Model

Model Building Break-Even Analysis (5 of 7)

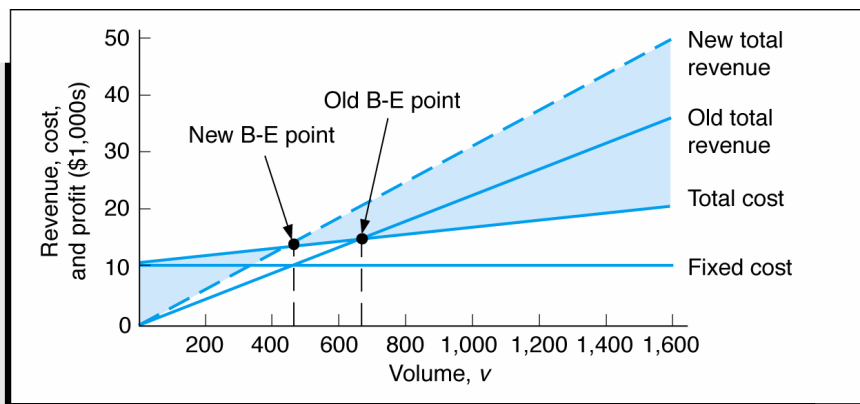


Figure 1.3
Sensitivity Analysis - Break-even Model with a Change in Price

Model Building Break-Even Analysis (6 of 7)

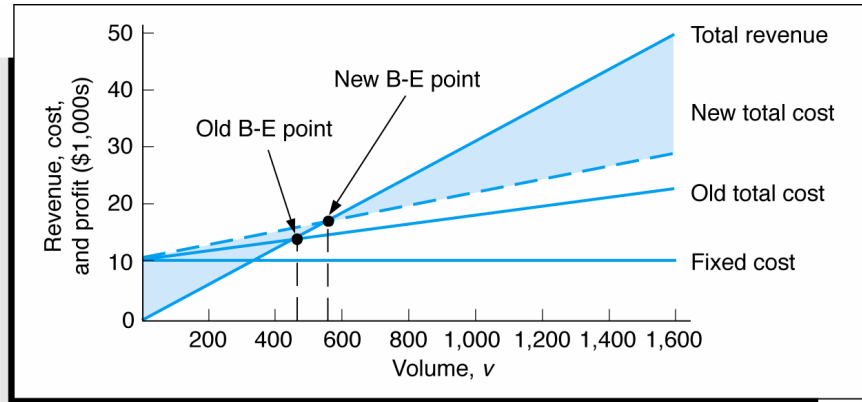


Figure 1.4
Sensitivity Analysis - Break-Even Model with a Change in Variable Cost

Model Building Break-Even Analysis (7 of 7)

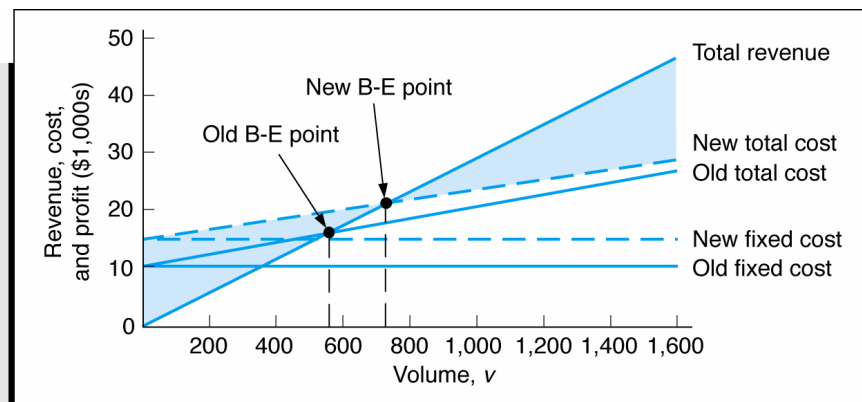


Figure 1.5
Sensitivity Analysis - Break-Even Model with a Change in Fixed Cost

Break-Even Analysis Excel Computer Solution (1 of 5)

Microsoft Excel - CH01-BE.xls

File Edit View Insert Format Tools Data Window Help

Arial 10 B I U

D10 =D4/(D6 - D5)

	A	B	C	D	E	F	G	H	I
1									
2		Break-Even Analysis for Western Clothing Company Example							
3									
4			Fixed cost =	10,000					
5									
6			Variable cost =	8					
7									
8			Price =	23					
9									
10			v =	666.7					
11									
12									

Exhibit 1.1

Break-Even Analysis Excel QM Computer Solution (2 of 5)

Spreadsheet Initialization

Title: Break-Even Analysis for Western Clothing Company Example

Options

- Volume analysis
- Graph

Use Default Settings

Help Cancel OK

Exhibit 1.2

Break-Even Analysis Excel QM Computer Solution (3 of 5)

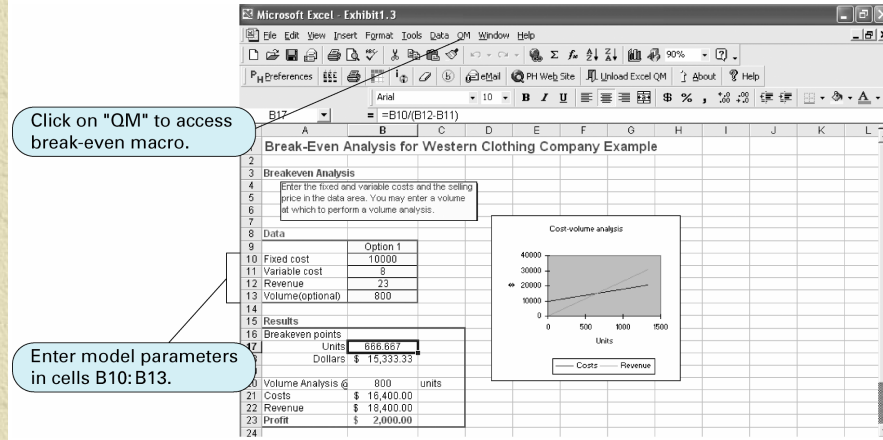


Exhibit 1.3

Break-Even Analysis QM for Windows Computer Solution (4 of 5)

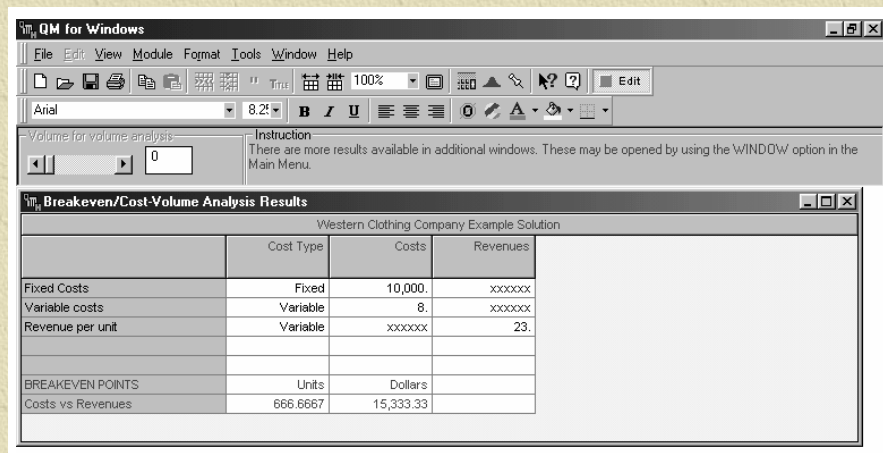


Exhibit 1.4

Break-Even Analysis QM for Windows Computer Solution (5 of 5)

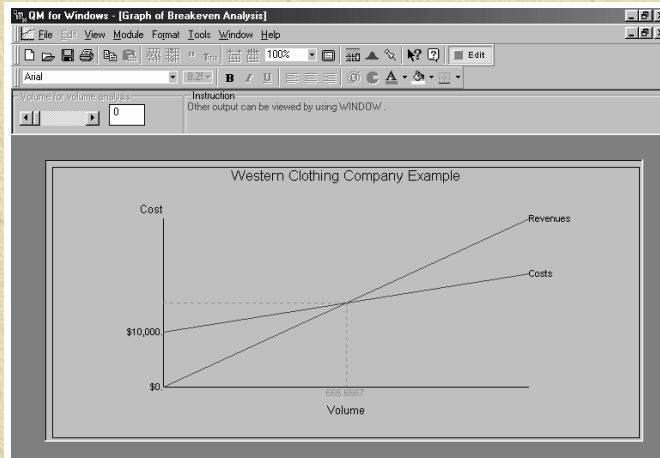


Exhibit 1.5

Management Science Modeling Techniques

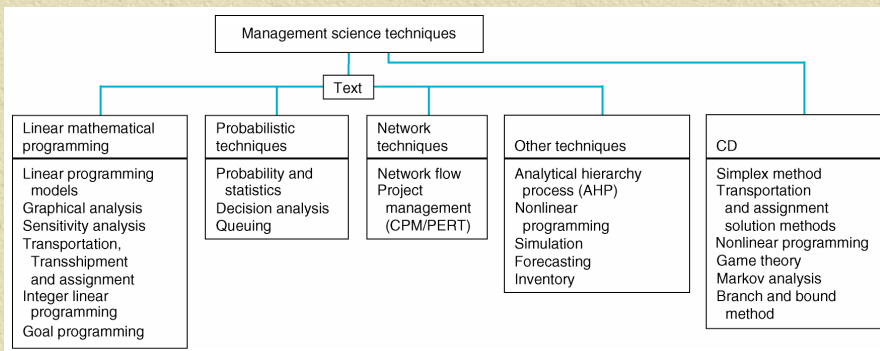


Figure 1.6
Modeling Techniques

Characteristics of Modeling Techniques

- ✚ **Linear Mathematical Programming** - clear objective; restrictions on resources and requirements; parameters known with certainty.
- ✚ **Probabilistic Techniques** - results contain uncertainty.
- ✚ **Network Techniques** - model often formulated as diagram; deterministic or probabilistic.
- ✚ **Forecasting and Inventory Analysis Techniques** - probabilistic and deterministic methods in demand forecasting and inventory control.
- ✚ **Other Techniques** - variety of deterministic and probabilistic methods for specific types of problems.

Business Use of Management Science

- ✚ Some application areas:
 - Project Planning
 - Capital Budgeting
 - Inventory Analysis
 - Production Planning
 - Scheduling
- ✚ **Interfaces** - Applications journal published by Institute for Operations Research and Management Sciences

Management Science Models Decision Support Systems (1 of 2)

- ✚ A **decision support system (DSS)** is a computer-based system that helps decision makers address complex problems that cut across different parts of an organization and operations.
- ✚ A DSS is normally **interactive**, combining various databases and different management science models and solution techniques with a user interface that enables the decision maker to ask questions and receive answers.
- ✚ **Online analytical processing system (OLAP)**, the **analytical hierarchy process (AHP)**, and **enterprise resource planning (ERP)** are types of decision support systems.
- ✚ Decision support systems are most useful in answering “what-if?” questions and performing sensitivity analysis.

Management Science Models Decision Support Systems (2 of 2)

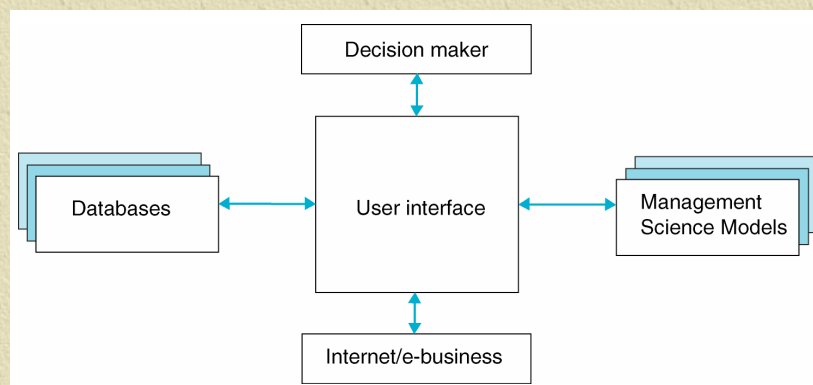


Figure 1.7
A Decision Support System

