2 CHAPTER

Data, Reality, and Problem Solving

When you encounter data, ask yourself: is the data credible? Consider the following questions:

1. Is the concept under study adequately reflected by the proposed measurements?

2. Is the data measured accurately?

3. Is there a sufficient quantity of the data to draw a reasonable conclusion?

The Scientific Method

1. Gather information about the phenomenon being studied;

2. On the basis of the data, formulate a preliminary generalization or hypothesis;

3. Collect further data to test the hypothesis;

4. If the data and other subsequent experiments support the hypothesis, it becomes a ~~theory~~

PROCEDURE

Decision-Making Method

1. Clearly define the problem and any influential variables.

2. Decide upon objectives and decision criteria for choosing a solution.

3. Create alternative solutions.

4. Compare alternatives using the criteria established in the second step.

5. Implement the chosen alternative.

6. Check the results to make sure the desired results are achieved.
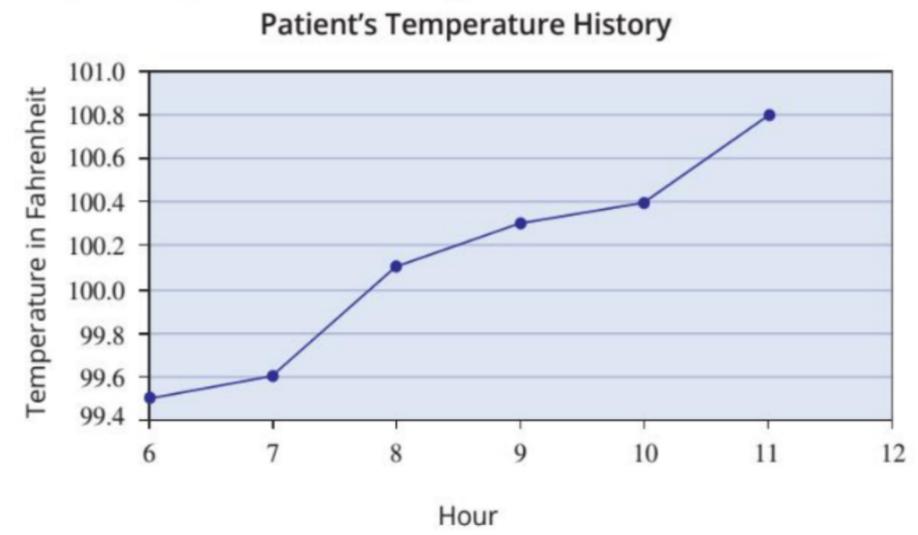
PROCEDURE

Confounding Variables

Confounding variables are "extra" variables that are not accounted for during experimentation and can cause results to become skewed.

DEFINITION

Late Deliveries Each Week

Figure 2.1.1

Patient's Temperature History

Collecting Data

Essentially, there are two ways to obtain data: **observation** and **controlled experiments**.

Response Variable

A **response variable** measures the outcome of interest in a study.

DEFINITION

Explanatory Variable

An **explanatory variable** causes or explains changes in a response variable.

DEFINITION

Suppose a new species of tomato has been genetically engineered to increase yields.
The question: Does the new species produce higher yields?

Plot 1	Plot 2	Plot 3	Plot 4
Plot 5	Plot 6	Plot 7	Plot 8
Plot 9	Plot 10	Plot 11	Plot 12
Plot 13	Plot 14	Plot 15	Plot 16

Example 2.1.2

Does an SAT preparation course improve performance on the SAT?

Placebos

A **placebo** is a fake treatment that has the potential to cause a response.

DEFINITION

London scientists conducted a study to determine if chocolate can trigger migraines. Twelve migraine-prone subjects were given a peppermint-laced chocolate candy and eight migraine-prone subjects were given a peppermint-laced placebo made of carob, peppermint, and vegetable fat. Five subjects from the group given chocolate developed a migraine headache within one day. No one from the group given the placebo developed a migraine in the same time period.[2]

a.   Which phase of the Scientific Method best describes this study?

b.   Is this an observational study or a controlled experiment?

c.   What is the response variable?

d.   What is the explanatory variable?

e.   Which group is the treatment group?

f.   Which group is the control group?

An article appearing in the *New England Journal of Medicine* investigated whether the academic performance of asthmatic children being treated with the drug Theophylline was inferior to a non-asthmatic group. In one part of the study, 72 children were identified as being treated for asthma. For each child with asthma, a non-asthmatic sibling was also identified. (The use of sibling controls allows for control of family environment and certain genetic factors on academic achievement.) All 144 children were then given a test to measure academic achievement. There were no significant differences on the test between the two groups.

a.   Why is this study an example of a controlled experiment?

b.   What is the explanatory variable?

c.   What is the response variable?

d.   Is there a control group in the study? Explain.

e.   Suppose that the data was gathered from an observational study instead of from a controlled experiment. How would this affect the conclusions that might be made from the study?

The Nurse's Health Study conducted on 87,245 women at Boston's Brigham and Women's Hospital revealed that women who eat a cup of beta carotene-rich food a day have 40 percent fewer strokes and 22 percent fewer heart attacks than those who consume a quarter of a cupful per day.[3]

b. Is this an observational study or a controlled experiment?

c. What is the response variable?

d. What is the explanatory variable?

e. Which group is the treatment group?

f. Which group is the control group?