34. Scale for Rating Food A group of students develops a scale for rating the quality of cafeteria food, with 0 representing "neutral: not good and not bad." Bad meals are given negative numbers and good meals are given positive numbers, with the magnitude of the number corresponding to the degree of badness or goodness. The first three meals are rated as 2, 4, and −5. What is the level of measurement for such ratings? Explain your choice.

35. Interpreting Temperature Increase In the *Born Loser* cartoon strip by Art Sansom, Brutus expresses joy over an increase in temperature from 1° to 2°. When asked what is so good about 2°, he answers that "it's twice as warm as this morning." Explain why Brutus is wrong yet again.

1-4 Collecting Sample Data

Key Concept An absolutely critical concept in applying methods of statistics is consideration of the method used to collect the sample data. Of particular importance is the method of using a *simple random sample*. We will make frequent use of this sampling method throughout the remainder of this book.

As you read this section, remember this:

> **If sample data are not collected in an appropriate way, the data may be so utterly useless that no amount of statistical torturing can salvage them.**

Part 1 of this section introduces the basics of data collection, and Part 2 describes some common ways in which observational studies and experiments are conducted.

Part 1: Basics of Collecting Data

Statistical methods are driven by the data that we collect. We typically obtain data from two distinct sources: *observational studies* and *experiments*.

DEFINITIONS

In an **observational study,** we observe and measure specific characteristics, but we don't attempt to *modify* the subjects being studied.

In an **experiment,** we apply some *treatment* and then proceed to observe its effects on the subjects. (Subjects in experiments are called **experimental units.**)

Experiments are often better than observational studies, because experiments typically reduce the chance of having the results affected by some variable that is not part of a study. (A **lurking variable** is one that affects the variables included in the study, but it is not included in the study.) In one classic example, we could use an observational study to incorrectly conclude that ice cream causes drownings based on data showing that increases in ice cream sales are associated with increases in drownings. Our error is to miss the lurking variable of temperature and thus fail to recognize that warmer months result in both increased ice cream sales and increased drownings. If, instead of using data from an observational study, we conducted an *experiment* with one group treated with ice cream while another group got no ice cream, we would see that ice cream consumption has no effect on drownings.

Example 1 Observational Study and Experiment

Observational Study: The typical survey is a good example of an observational study. For example, the Pew Research Center surveyed 2252 adults in the United States and found that 59% of them go online wirelessly. The respondents were asked questions, but they were not given any treatment, so this is an example of an observational study.