Section X.1

Observational Studies, Designed Experiments, and Sample Surveys

# Objective 1: Distinguishing Between an Observational Study and an Experiment

Once a research question is developed, it is necessary to develop methods for obtaining the data that can be used to answer the question posed. There are two methods for collecting data, **observational studies** and **designed experiments**.

In an observational study, a researcher collects information about a population by measuring a variable of interest but does not impose a treatment on the subjects. Observational studies do not allow a researcher to claim causation, only association.

In a designed experiment, an investigator imposes a change or treatment on one or more groups. One type of experiment is a **comparative experiment**. This is where a **control group** is given a placebo to compare the reactions between the **treatment group** and the control group.

Determine whether the study depicts an observational study or an experiment. Explain your reasoning.

a. Football players are randomly divided into two groups. One group enrolls in a ballet class, and the other enrolls in a yoga class. After two months, each group is given a running test to compare mobility.

b. A study is conducted to determine whether there is a relationship between texting and car accidents. Researchers look at the accident records for $1000$ accidents to see whether texting was listed as a factor in the crash.

# Objective 2: Sampling

Observational studies can be conducted by administering a survey. When administering a survey, the researcher must identify the population that is to be targeted. For example, the population of interest might be Americans aged $18$ years or older. Since it would be impossible to survey all adult Americans, the researcher will typically survey a **random sample** of about $1000$ adult Americans.

Random sampling is the process of using chance to select individuals from a population to be included in the sample.

For results of a survey to be reliable, the characteristics of the individuals in the sample must be representative of the characteristics of the individuals in the population. The key to obtaining a sample representative of a population is to let randomness play a role in dictating which individuals are in the sample rather than convenience.

Suppose you wanted to learn the proportion of students at your high school who work.

a. Explain why surveying the students in your math class may not be the best method for selecting a random sample.

b. Describe a better method for selecting a random sample of students at your high school for the survey.

# Objective 3: Bias in Sampling

Remember that the goal of sampling is to obtain information about a population through a sample. If the results of the sample are not representative of the population, then the sample has **bias**.

There are three sources of bias in sampling:

1. Sampling bias
2. Nonresponse bias
3. Response bias

**Sampling bias** means that the technique used to obtain the sample’s individuals tends to favor one part of the population over another. Any convenience sample has sampling bias.

**Nonresponse bias** exists when individuals selected to be in the sample who do not respond to the survey have different opinions from those who do.

**Response bias** exists when the answers on a survey do not reflect the true feelings of the respondent. Response bias can occur due to a number of factors such as interviewer error, misrepresented answers, wording, or the order of the questions.

Describe the type of bias in the survey, and suggest a way to remedy the problem.

a. A survey asks “Do you oppose the reduction of estate taxes?”

b. A polling organization sends out $1200$ questionnaires and $100$ people respond.

c. A researcher is conducting a study about income levels of households within a town and sends an interviewer to $50$ homes in the same neighborhood.