CHAPTER 2

DEFINITIONS AND SCALING

OBJECTIVES

After completing this chapter, you should

- be able to define terms important for statistics, such as variable (independent and dependent), population and parameter, sample and statistic, and sampling.
- be able to define and illustrate the rules used for assigning numbers to objects or events–that is, be able to discuss measurement as it pertains to statistics.
- be able to define and illustrate the two basic uses or divisions of statistics (inferential and descriptive).

CHAPTER REVIEW

A *variable* is anything that may take on different values or amounts. In research, two variables of interest are the independent variable and the dependent variable. The *independent* variable is the one manipulated or controlled by the researcher. The *dependent* variable in behavioral science is the measurement of behavior.

Population refers to a complete collection of objects or organisms having some common characteristic. A subset of a population is called a *sample.* A measurable characteristic of a population is called a *parameter,* whereas a measurable characteristic of a sample is called a *statistic.*

The process of selecting a sample from a population is called *sampling.* If a sample accurately reflects its parent population, it is an *unbiased* sample; an unrepresentative sample is called *biased.* In *random sampling,* each member of the population theoretically has a chance of being selected; random sampling is sometimes called *random and independent sampling* or just *independent sampling* because selecting one object or person for a sample has no effect (is independent of) the probability of selecting another object or person. *Sampling with replacement* means that each selected individual is returned to the population before the next selection; in *sampling without replacement,* the individual is not returned. In *stratified random sampling,* the population is divided into strata or groups, and random samples are taken from each strata.

Two basic types of data are measurement data and frequency data. *Measurement data* involve a true measurement process, whereas *frequency data* consist of counts, totals, or frequencies. Nominal scale data are generally frequency data, whereas ordinal, interval, and ratio scale data involve some form of measurement.

Scales of measurement are the rules used for assigning numbers to objects or events. From least to most complex, the measurement scales are nominal, ordinal, interval, and ratio. The *nominal scale* gives names or labels to different objects or events. Numbers on football jerseys are a nominal scale. *Ordinal scale* numbers serve both to identify and to rank-order the objects or events. An example of an ordinal scale might be the numbers 1–6 used both to identify finishers in a 5K race and to indicate their order of finish. In addition to providing categorizing and ranking properties, the *interval scale* has equal intervals between the scores. An example is the Fahrenheit temperature scale. Rating scales can cautiously be assumed to be interval-level measurement. A *ratio scale* is an interval scale with a true zero. Examples include time and weight. It is important to be aware of scales of measurement because some statistical techniques require particular scales of measurement.

Descriptive statistics are used to illustrate quantities of numerical observations. Examples include graphs and averages. *Inferential* statistical techniques permit us to make conclusions about a larger group based on some subset of it and tell us how confident we are in our conclusions.

TERMS TO DEFINE AND/OR IDENTIFY

variable

independent variable

dependent variable

population

parameter

sample

statistic

sampling

unbiased sample

biased sample

random sampling

random and independent
sampling

independent sampling

sampling with replacement

sampling without replacement

stratified random sampling

scales of measurement

measurement data

frequency data

nominal scale

ordinal scale

ranking

rank-ordering

interval scale

ratio scale

descriptive statistics

inferential statistics

FILL-IN-THE-BLANK ITEMS

Statistics: Some Basic Vocabulary

The general term used to designate anything that may take on different values or amounts is

(1) _____. The (2) _____ variable is the one controlled and manipulated by

the experimenter; the (3) _____ variable in psychology is the measurement of behavior. For

example, suppose an experimenter wants to test the effect of different amounts of alcohol on driving

ability. She gives three different groups either 0, 1, or 2 ounces of alcohol, respectively. After a suitable

period, some characteristic of driving ability is measured in each participant. The amount of alcohol given

is the (4) _____ variable, whereas the measured driving ability is the

(5) _____ variable.

   A complete collection of objects or organisms is called a (6) _____, and a subset of the

collection is a (7) _____. A measurable characteristic of the complete collection is called a

(8) _____, whereas a similar characteristic of the subset is a (9) _____.

   A sample that is not representative of the population of interest is called a (10) _____

sample. One way to get a representative sample is to use (11) _____ sampling, a sampling

method in which each population member has an equal chance of being chosen. If individuals are returned

to the population after they are selected, this is called sampling with (12) _____. In

(13) _____ random sampling, the population is divided into relevant groups, and random

samples are taken from each group.

Scales of Measurement

The rules used for assigning numbers are called (14) _____ of measurement. Data derived

by some kind of true measurement process are called (15) _____ data, whereas data

consisting of counts, totals, or frequencies are considered (16) _____ data. The type of scale

that provides nothing more than a name or label is called a (17) _____ scale. If the scale

numbers are used both for categorizing and for ranking, the scale is called an (18) _____

scale. Equal intervals between numbers characterize the (19) _____ scale, and if the scale

has a true zero point, we call it a (20) _____ scale. Weight is an example of a

(21) _____ scale, whereas the Fahrenheit temperature scale is an example of an

(22) _____ scale.

Two Basic Uses of Statistics

(23) _____ statistics consists of techniques used to illustrate or describe the data, whereas

(24) _____ statistics is used to draw conclusions from the data. A graph is an example of a

(25) _____ statistic.

PROBLEMS

1. For each of the following brief descriptions, decide which is the independent variable and which is the dependent variable.

   a. Thirty people have been given one of three different kinds of drugs, and their responses on a standard IQ test have been recorded.

   b. A social psychologist studies the problem-solving performance of individuals working alone or working in the presence of others.

   c. One group of third-graders solves simple multiplication problems with odd-numbered answers. Another group of third-graders solves multiplication problems with even-numbered answers. The average number of seconds to solve the problems for each group is compared.

   d. In a study of visual acuity, participants view a standard stimulus under low illumination, moderate illumination, or high illumination. The length of time each participant takes to identify the stimulus is recorded.

2. Give the appropriate measurement scale for each of the following:

   a. weight

   b. Social Security numbers

   c. scores assigned by a rating scale of authoritarian characteristics

   d. telephone numbers

e. highway speed limits

f. national college basketball ratings

g. judges' ratings of gymnastics performance

h. temperature centigrade

3. Tell whether each of the following is a parameter or a statistic. Explain your choice.

   a. the average weight of all left-handed boys at Fairlawn High School

   b. the average ACT (or SAT) scores of 15 randomly selected students from your statistics class

   c. the range in IQ scores of all inmates in the state prison in your state

   d. the average income of a group of people selected by calling every 100th name in a small-town telephone directory

4. Read each of the following and tell whether a descriptive statistical technique or an inferential statistical technique has been used.

   a. A commentator on the nightly business report uses a pie chart to show how the average American family spends its money.

   b. A newspaper article describes how a study of 27 Alzheimer's patients concluded that patients benefited from lecithin and physostigmine injections.

c. A study based on a small sample concludes that calories consumed in a morning meal cause less weight gain than the same calories consumed at night.

d. Your statistics instructor gives the range of scores and the average score on the midterm test.

e. A study shows that law students who take special review courses perform better on the bar exam than students who do not take the courses.

f. A newspaper publishes a graph showing the performance of the stock market in the month of July.