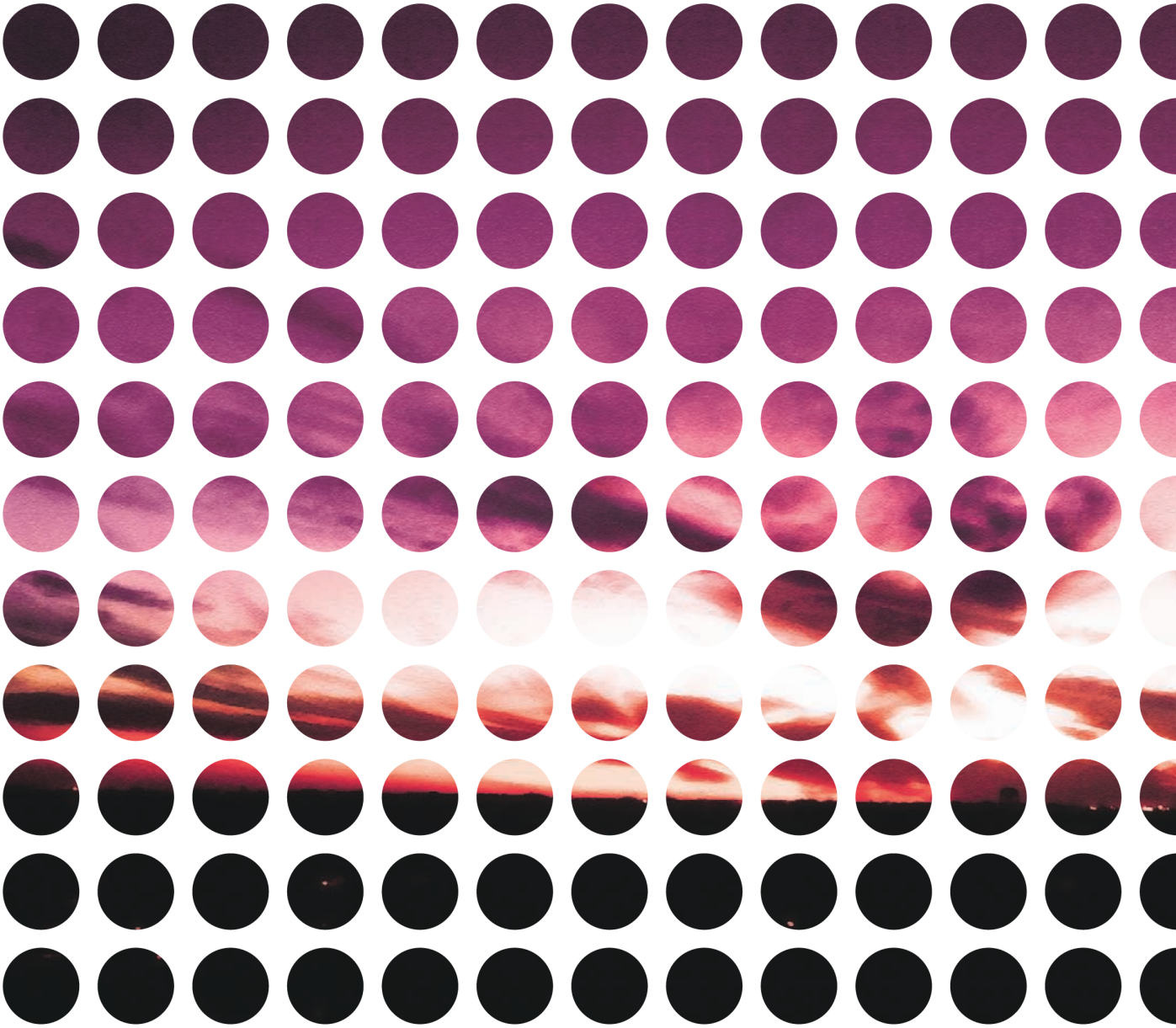

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Evidence-Based Inquiry

James McMillan Sally Schumacher

Seventh Edition

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CHAPTER SUMMARY

Test your understanding of the fundamental principles of sampling in quantitative studies by going to MyEducationLab for Research at www.myeducationlab.com. Click on the topic "Selecting a Sample" and then select the Building Research Skills exercise titled "Sampling in a Quantitative Study."

This chapter has introduced fundamental principles of sampling used in quantitative studies. This discussion has included types of sampling procedures and a discussion of how sampling can affect the credibility and generalizability of the results. Key points include the following:

1. The unit of study is typically the number of subjects in the study and affects the nature of statistical analyses.
2. In probability sampling, a small percentage of the population is obtained randomly to be analyzed in order to make inferences about characteristics of the population.
3. Probability sampling procedures include simple random sampling, systematic sampling, stratified sampling, and cluster sampling.
4. Systematic sampling involves choosing individuals from a list and is as random as simple random sampling.
5. Stratified sampling, where subjects are selected from subgroups within the population, is used to decrease the margin of error in estimating population values and save resources. It is applied to represent the population proportionately or disproportionately.
6. Margin of error is used to report likely values for the population.
7. In nonprobability sampling there is no random sampling from the population. Rather, subjects are determined on the basis of availability, the purpose of the study, and the number of subjects needed (quota). This limits generalizability of the findings to similar individuals.
8. Sample size is critical for both accuracy and statistical purposes. Studies with a small number of subjects and lack of statistical significance are problematic.
9. The characteristics of the sample are important in determining subject motivation, sampling bias, and response variability. Subjects should be selected so that there is variation of responses to key variables.
10. Volunteer samples may provide biased results. Volunteers, compared to nonvolunteers, tend to be less conforming, have higher aptitude, and come from a higher socioeconomic group.

APPLICATION PROBLEMS

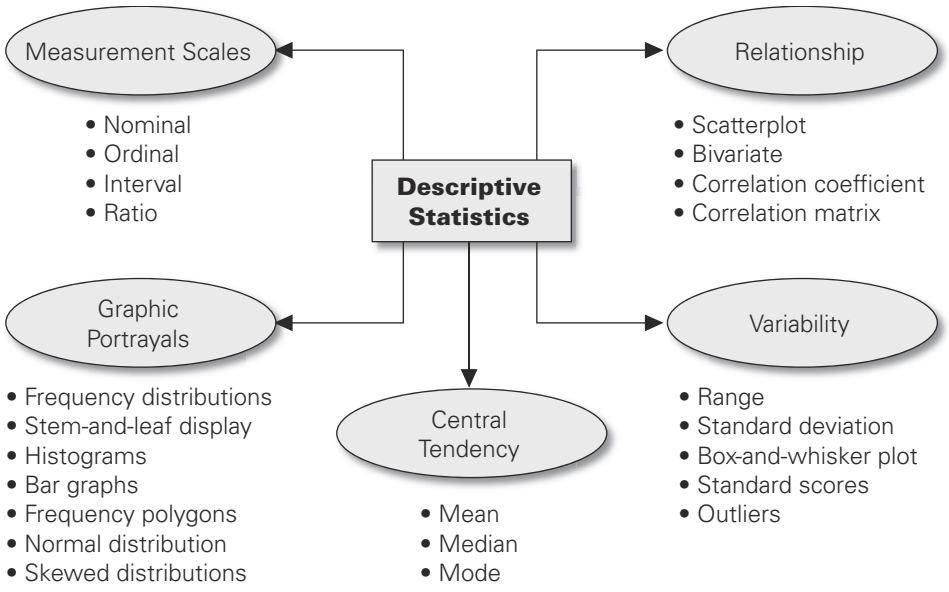
1. A researcher wants to make sure that a sufficient number of subjects is selected from a specific age category. Which type of sampling would be best?
2. Which sampling procedures (select from among all probability or nonprobability types) are illustrated in the following situations?
   a. Mr. Brown decides to assess his teachers' attitudes toward teaching autistic children. He identifies the teachers who have such students and interviews them to determine their attitudes.
   b. In this study Dr. Mathews wants to report to the board of education about the achievement of ESL students. He first identifies all the ESL students and then chooses 10 percent of them.
   c. Vicki Paris decides to do a study comparing children with high self-efficacy to those with low self-efficacy in order to see if there are differences in motivation and engagement. She identifies four classes to participate and surveys all the students in these classes.
   d. Paul Gerber is investigating the relationship between type of community (urban, rural, or suburban) and size of school. He obtains a list of all schools in the state, identifies each as urban, rural, or suburban, and then randomly selects 30 schools from each of the three categories.
   e. Lisa Abrams is conducting a study on the attitudes of faculty. She wants to know if there is a relationship between tenure status and job satisfaction and finds 54 faculty in her institution who are willing to complete the survey.
   f. In a study of high-stakes testing and student motivation, Dr. Hall identifies a group of schools with high student motivation ($n = 34$) and a group with low student motivation ($n = 55$). Dr. Hall then compares the achievement scores of the two groups of schools.
3. Give an example of a sampling procedure that has the following characteristics: a population of 400 and systematic sampling of every 20th student.
4. With a random number generator on statistical software, such as SPSS, and a database, select one simple random sample and one systematic sample. Compare the results.
5. Describe a study that has the following characteristics: fifth-grade students in seven schools, nonprobability,

purposeful, with two independent and two dependent variables.
6. Describe a study that has these characteristics: a stratified random sample based on two stratifying independent variables and one dependent variable.
7. What would be the four most significant points about sampling that you would present to a group of teachers who want to conduct a study in their own schools? Why?
8. What would be the best sampling strategy for a researcher who wants to conduct studies that would have the following strengths?
   a. Least amount of money and time used to conduct the study with probability sampling.
   b. Subjects from each subgroup are included.
   c. Simple for others to understand.
   d. Provides the most representative nonprobability sample.

ANSWER TO THE APPLICATION PROBLEMS

1. The best strategy would be to use a stratified random sample based on age categories and then take a nonproportional sample from each category to ensure an adequate number of subjects from each category.
2. a. nonprobability, purposeful
   b. probability, simple random sample, proportional
   c. nonprobability, convenience
   d. probability, stratified random sample, nonproportional (because of the same *n* from each group)
   e. nonprobability, convenience
   f. nonprobability, purposeful
3. (individual student response)
4. (individual student response)
5. (individual student response)
6. (individual student response)
7. (individual student response)
8. a. stratified random sample
   b. disproportional stratified random sample
   c. nonprobability—convenience or availability sampling; probability—simple random sampling
   d. quota sampling

Descriptive Statistics



KEY TERMS

statistics
descriptive statistics
inferential statistics
measurement scales
nominal
ordinal
interval
ratio
univariate
bivariate
frequency distribution
stem-and-leaf display
histogram
bar graph
frequency polygon
measures of central tendency
mean
median
mode
normal distribution
skewed
positively skewed
negatively skewed
kurtosis
measures of variability
range
standard deviation
percentile rank
variance
box-and-whisker plot
standard scores
z-score
outlier
scatterplot
correlation coefficient

WHAT YOU WILL LEARN

Study this chapter and you will:

- Differentiate between different types of statistics and levels of measurement.
- Understand the relationship between descriptive and inferential statistics.
- Be able to use frequency distributions and other graphic presentations of data.
- Explain how measures of central tendency are used to describe a dataset.
- Explain how measures of variability are used to describe a dataset.
- Understand the importance of outlier analysis.
- Know how bivariate correlations are used to measure relationships.
- Explain why scatterplots are essential for interpreting correlations.

INTRODUCTION TO DESCRIPTIVE STATISTICS

Quantitative research relies heavily on numbers in reporting results, sampling, and providing estimates of score reliability and validity. The numbers are often accompanied by unrecognized strange words and even stranger symbols, and are manipulated by something called *statistics*. Like magic, statistics lead to conclusions. Many readers of research simply prefer to skip over anything related to statistics. In the words of a prominent specialist in educational measurement: "For most educators, mere contemplation of the term 'statistics' conjures up images akin to bubonic plague and the abolition of tenure" (Popham, 1981, p. 66).

Even though some statisticians may like the image just described, in truth the fundamental concepts and principles of statistics are readily comprehensible. Advanced skills in mathematics are not a prerequisite to understanding statistics, and there is no need to memorize complex formulas. In fact, learning about statistics can actually be fun! (Consider the great new words learned that will be perfect for impressing friends and family.)

More seriously, there are important reasons for all educators to gain a functional command of statistical principles:

1. To understand and critique professional articles (for example, were appropriate statistical tools used?)
2. To improve evaluation of student learning
3. To conduct, even in modest and informal ways, research studies (for example, how should the results be analyzed?)

4. To understand evaluations of programs, personnel, and policies
5. To become better equipped as a citizen and consumer, making decisions based on quantitative data or arguments
6. To upgrade the education profession by providing standard skills to communicate, debate, and discuss research that has implications for educational practice

Types of Statistics

Statistics: tools for understanding data

Statistics are methods of organizing and analyzing quantitative data. These methods are tools designed to help the researcher organize and interpret numbers derived from measuring a trait or variable. The mere presence of statistical procedures does not ensure high quality in the research. Although the contribution of some results does depend on applying the correct statistical procedure, the quality of the research depends most on proper conceptualization, design, subject selection, instruments, and procedures. Statistics is an international language that only manipulates numbers. Statistics and numbers do not interpret themselves, and the meaning of the statistics is derived from the research design. Of course, the improper use of statistics invalidates the research, but the interpretation of statistical results depends on carefully designing and conducting the study—that is, it depends heavily on producing high-quality quantitative data.

Descriptive statistics: summarizes data

There are two broad categories of statistical techniques: descriptive and inferential. **Descriptive statistics** transform a set of numbers or observations into indices that describe or characterize the data. Descriptive statistics (sometimes referred to as *summary statistics*) are thus used to summarize, organize, and reduce large numbers of observations. Usually, the reduction results in a few numbers derived from mathematical formulas to represent all observations in each group of interest. Descriptive statistics portray and focus on *what is* with respect to the sample data—for example, What is the average reading grade level of the fifth-graders in the school? How many teachers found the in-service valuable? What percentage of students want to go to college? and What is the relationship between the socio-economic status of children and the effectiveness of token reinforcers? The use of descriptive statistics is the most fundamental way to summarize data, and it is indispensable in interpreting the results of quantitative research.

Inferential statistics: describes the probability of results for populations

Inferential statistics, on the other hand, are used to make inferences or predictions about the similarity of a sample to the population from which the sample is drawn. Because many research questions require the estimation of population characteristics from an available sample of subjects or behavior, inferential statistics are commonly used in reporting results. Inferential statistics depend on descriptive statistics. Without a complete understanding of descriptive statistics, therefore, inferential statistics make very little sense. Figure 7.1 illustrates the relationship between descriptive and inferential statistics. It shows how a researcher would first take a sample from a population, use descriptive statistics to describe the sample, and then use inferential statistics to estimate the true value of the test score for the population.

Researchers may choose from many types of descriptive statistics in characterizing a set of data. The choice usually depends on three factors: the type of measurement scale employed, assumptions about the data, and the purpose of the research. The purpose of the research, or *research problem*, actually depends on a knowledge of different statistical techniques, because each technique offers information for answering particular kinds of questions. Hence, each of the common descriptive techniques is presented here, with examples of the research problems it addresses.

To practice using descriptive statistics related to a research plan, go to MyEducationLab for Research at www.myeducationlab.com. Click on the topic "Descriptive Statistics" and then select "Computing Descriptive Statistics."

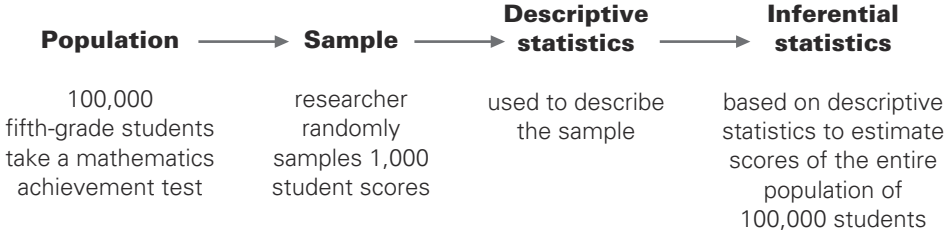


FIGURE 7.1 **Relationship of Descriptive to Inferential Statistics**