

CHAPTER 1

Introduction

Summary _____

The overall purpose of the first chapter of the textbook is to introduce

1. broad categories and important terms used in statistics (for example, descriptive and inferential statistics, parameter, independent variable),
2. the organization of the book.

In addition to the usual introductory definitions, the text discussed the place that statistics occupies in various disciplines that utilize statistics. We hope that by seeing the number of areas that use statistics, we will convince you of the value of this course. The kind of reasoning that people use when they do statistics problems may be applied to many other situations that aren't the least bit statistical. Because of the general applicability of statistics, you will benefit if you use your best efforts in this course.

Statistics is a dynamic discipline. There are changes in the practice of statistics (such as changing from hand calculators to computers), and in theoretical applications (such as the notion of how to interpret different statistical tests). One of the goals of the text is to provide you with a snapshot of statistics in the early 21st century and help you understand how statistics have evolved into their current state. No doubt statistics will continue to change in the future!

The notion of *descriptive statistics* is pretty simple and straight-forward: a single number is used to capture a particular characteristic of a set of data. *Inferential statistics* is a set of procedures that allow you to make a decision about a population even though all your information comes from a sample. The assumption with inferential statistics is that your results are influenced by change and random factors that are not under your control. With inferential statistics, you can make predictions that are likely to be true, but cannot be proved absolutely.

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The idea of using a *sample* as a substitute for a larger, unmeasurable *population* will be found in every chapter that follows. The characteristics of samples, *statistics*, and the characteristics of populations, *parameters*, are easy to keep straight. The two *p*'s go together and the two *s*'s go together.

Quantitative and *qualitative variables* find their way into the text in several chapters after this first one. Quantitative variables have *lower* and *upper limits* and are expressed in amounts. Qualitative variables have names and are expressed as kinds. The names in a qualitative variable may or may not have the characteristic of order.

With a *ratio* scale of measurement, a zero means a complete absence of the thing measured. Also, ratio statements such as "twice as much" and "reduced by one-third" make sense. Such ratio statements don't make sense if the variable is measured on an *interval* scale. Also, for interval scales, zero is just a convenient starting place; it doesn't mean zero amount. Like the ratio scale, however, equal distances on interval scales represent equal amounts of the variable.

For variables measured with *ordinal* scales, equal distances between numbers do not mean equal amounts of the variable. A larger number means more, but it doesn't tell you how much more. The difference between 5 and 10 on an ordinal scale is not the same as the difference between 10 and 15. *Nominal* scales have the least information of all. On a nominal scale, different numbers mean only that the things being measured are different.

If you understand the topic of *experimental design*, you can plan the procedures necessary to gather data. If you understand the topic of *statistics*, you can analyze the data. A good researcher should be able to do both well.

The distinctions between *independent*, *dependent*, and *extraneous* variables, which are troublesome for many students, will appear again and again, both in the text and in your academic career. Do all the study guide problems that ask you to make these distinctions.

Epistemology is the study of knowledge. Some knowledge is created by using reason, one example of which is a technique called statistics.

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The text's abbreviated 200-year history of statistics concentrates on the beginnings of institutions and the beginnings of statistics courses. Can you cite some dates? Four levels of competence in statistics are described. Can you list them? As described earlier, statistics is a dynamic discipline. It will continue to change and develop.

You will probably spend several hours with this study guide. Your study guide notes will be valuable during the course, as you prepare for any final examinations, and in future courses that use statistics. If you have any comments or suggestions, please e-mail Chris Hakala at chakala@wnec.edu.

Multiple-Choice Questions _____

1. Inferential statistics allow a researcher to
 - (1) select representative samples;
 - (2) make decisions about populations;
 - (3) characterize a set of data with one number or name;
 - (4) all of the above.

2. The Zeigarnik effect
 - (1) is the distinction between statistics and experimental design;
 - (2) is that numbers mean different things depending on the scale of measurement;
 - (3) is a phenomenon of memory;
 - (4) all of the above.

3. Which of the following was not described as a benefit of a course in statistics?
 - (1) conclusions may be made with certainty;
 - (2) a tool used in several disciplines is learned;
 - (3) you get an education in decision making;
 - (4) you are better able to communicate with others.

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4. _____ are used as estimates of parameters
- (1) Statistics;
 - (2) Constants;
 - (3) Populations;
 - (4) Upper limits.
5. Five means more than three on the
- (1) ordinal scale;
 - (2) interval scale;
 - (3) ratio scale;
 - (4) all of the above.
6. Many schools rank their graduates each year from highest to lowest. Graduates wind up with scores such as 21 and 111. Such a scale is one example of a(n) _____ scale.
- (1) nominal;
 - (2) ordinal;
 - (3) interval;
 - (4) ratio.
7. On the _____ scale, zero means a complete absence of the thing measured.
- (1) ordinal;
 - (2) interval;
 - (3) ratio;
 - (4) all of the above.
8. Epistemology deals with the nature of
- (1) reason;
 - (2) experience;
 - (3) mathematics;
 - (4) knowledge.

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9. In a study of the effect of handedness on athletic ability, participants were divided into three groups: right-handed, left-handed, and ambidextrous. Athletic ability was measured on a 12-point scale. The independent variable is _____; the number of levels of the independent variable is _____
- (1) athletic ability; three;
 - (2) athletic ability; twelve;
 - (3) handedness; three;
 - (4) handedness; twelve.
10. In the study of handedness and athletic ability, the dependent variable is _____
- (1) handedness;
 - (2) athletic ability;
 - (3) not described;
 - (4) both (1) and (2).
11. When numbers are used as substitutes for names, the numbers constitute a(n) _____ variable.
- (1) qualitative;
 - (2) quantitative;
 - (3) extraneous;
 - (4) independent.
12. If an experiment has two groups of participants and if both groups are "chronic schizophrenics," then chronic schizophrenia is most likely a(n) _____
- (1) independent variable;
 - (2) dependent variable;
 - (3) controlled extraneous variable;
 - (4) any of the above are likely.
13. In an experiment to determine the effect of a stimulant on amount of time spent studying, an extraneous variable would be _____
- (1) the stimulant;
 - (2) the time spent studying;
 - (3) both (1) and (2);
 - (4) neither (1) nor (2).

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14. A statistics student is interested in determining if studying in the room where class is held improves scores on a statistics exam. To do this, she has half the class study in their normal seats and the other half study in their rooms. In this experiment, an example of an extraneous variable would be
- (1) room temperature;
 - (2) where the students studied;
 - (3) both (1) and (2);
 - (4) neither (1) nor (2).
15. In an experiment on the effect of sleep on memory, the independent variable might be
- (1) number of hours of sleep;
 - (2) recall score on a test;
 - (3) gender of the subjects;
 - (4) gender of the experimenter.
16. Which of the following were listed among Kirk's four levels of statistical inference?
- (1) computer programmers who specialize in statistics;
 - (2) psychologists who apply statistical techniques;
 - (3) mathematical statisticians who develop statistical techniques;
 - (4) all of the above.
17. According to your text, the reason for doing an experiment using samples is to
- (1) find out about the sample;
 - (2) find out about the population;
 - (3) obtain numbers so that statistics may be calculated;
 - (4) obtain numbers so that parameters may be calculated.

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18. A researcher is interested in understanding differences between men and women on attitudes towards employment after the age of 70. To do this study, the experimenter asks 50 adults aged 25-30 to respond to a series of open ended questions. The experimenter then takes the data and looks for themes that correspond to her theory of personality. The variables measured in this study are
- (1) quantitative variables;
 - (2) basic variables;
 - (3) applied variables;
 - (4) qualitative variables.
19. What level of measurement would I use if I were to ask every member of my class what state they were born in, then count up the number from each state?
- (1) Nominal;
 - (2) Ordinal;
 - (3) Ratio;
 - (4) Interval.
20. Which of the following is a description of an independent variable?
- (1) number of rat's tail flicks;
 - (2) amount of aggression demonstrated by a participant following a video;
 - (3) whether or not a student takes a drug or a placebo;
 - (4) all are independent variables.

Short-Answer Questions _____

1. Distinguish between
 - a. descriptive and inferential statistics;
 - b. populations and samples;
 - c. interval and ordinal scales of measurement.

2. What is the difference between qualitative and quantitative variables?

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Problems

1. Undergraduates conducted each of the following studies. Identify:
 - a. the independent variable
 - b. the number of levels of the independent variable and their names
 - c. the dependent variable
 - d. a controlled extraneous variable
 - e. a variable measured with a nominal scale
 - f. another variable and the scale used to measure it
 - g. Write an explanation of what the study shows.
 - A. Natalie covered the walls of three small rooms with red, blue, or white paper. Participants in her study entered a room, worked on 3 difficult logic problems for 10 minutes, and then filled out a mood survey. For the 36 participants, the mood survey scores ranged from 10 (calm) to 40 (agitated). The mean mood scores for the three rooms were red-24; blue-16; white-18.
 - B. Khiela interviewed 60 students who were about her age (20). She used a questionnaire that allowed her to classify the parenting style of the parents of those she interviewed. The parenting style classifications were authoritarian, authoritative, and permissive. After filling out the questionnaire, the students indicated their grade point average (GPA). An inferential statistical test did not reveal any statistically significant differences among the three groups.
2. Undergraduates conducted each of the following studies. Identify:
 - a. the independent variable
 - b. the number of levels of the independent variable and their names
 - c. the dependent variable
 - d. a controlled extraneous variable
 - e. a variable measured with an ordinal scale
 - f. another variable and the scale used to measure it
 - g. Write an explanation of what the study shows.

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- A. Social loafing occurs when people don't work as hard in a group as they work alone. For example, three people pulling on a rope exert less force than the sum of the three pulling individually. Kaycee wondered if social loafing occurs when the task is cognitive rather than physical. All participants worked at small tables in groups of three. Each individual worked on a word square (a 15 x 15 array of letters) for six minutes searching for 20 words hidden in the word square. Half of the 30 participants were told that the words they found would be averaged with the other two people at their table; the other half were told that their words were scored individually. The number of words circled was recorded for each participant; the mean was 7.6 words for participants working in groups and 9.6 words for participants working alone.
- B. Blaine was interested in the relationship between food spiciness and personality characteristics. The participants in Blaine's study were women who had not eaten for at least 3 hours. They first tasted three dips (with chips). One was mild, another medium, and one was hot. After indicating a preference, the participants filled out a risk survey that indicated their desire to engage in activities such as skydiving, bungee jumping, and driving fast. The three groups averaged about the same score on the risk survey.
3. What are the lower and upper limits of the following numbers?
- 1.3 minutes
 - 8 errors
 - 23°F
 - \$45.50
 - 10.00 grams
4. The following pairs represent the lower and upper limits of what numbers?
- 4.5-5.5
 - 6.35-6.45

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- c. .815-.825
 - d. 0.5-1.5
 - e. 652.35-652.45
5. Identify the kind of scale that each set of values comes from.
- a. Lieutenant, Captain, Major
 - b. anxiety disorder, phobic disorder, adjustment disorder
 - c. 50, 100, 250
 - d. 0°C, 20°C, 40°C
 - e. hat, shirt, shoes, pants
 - f. 1st place, 2nd place, 3rd place
 - g. 5 meters, 10 meters, 150 meters
6. Identify the scale of measurement for the items that follow.
- a. achievement-test scores
 - b. numbers assigned to identify groups in an experiment
 - c. numbers given to different sections of the same course
 - d. win, place, and show in a horse race
 - e. dollar amounts in a bank statement
 - f. rank order of teams in a sport based on wins and losses
 - g. amount of liquid in a fluid ounce
7. Identify each measurement below as being based on a quantitative or qualitative variable. For quantitative variables identify the lower and upper limits of the measurement.
- a. 414, dollars received from a part-time job
 - b. 16, cubic yards of dirt
 - c. 8, identification for Druid College among private schools in Transylvania
 - d. 3.0, millions of dollars in the budget
 - e. 101.9, km/hr registered on a radar machine used by the state police
 - f. 23.95, the time in seconds required for Sam to swim 50 yards
 - g. 4 minutes, 15 seconds, time to run a mile
 - h. 0.87, percentage of material recalled from a text

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8. Identify the quantitative variables below by writing in lower and upper limits on their blank lines. Write qualitative beside the variables that deserve such a name.

- a. 2 styles of sonnets
- b. 3 feet of paper
- c. 4 species of protozoa
- d. 5.0 seconds of time
- e. 6.05 grains of gold
- f. 7.95 decibels of noise
- g. 100 points on an IQ test
- h. 118 wins in a season by a baseball team
- i. 24 ways to describe love

9. A classic experiment by Warden (1931) measured the motivation of rats for food, water, or sex. After deprivation, a rat had to cross an electrified grid to get to the goal object. (The whole apparatus was called the Columbia Obstruction Box.) The amount of electrical shock a rat would tolerate and still cross was measured. (Thirst came out as the strongest motive.) Name the dependent and independent variable. Identify an extraneous variable that should have been controlled.
10. The importance of early psychic traumas of children as a precursor of cancer has been investigated. Psychic traumas were those in which emotional relationships brought pain and desertion. Of 450 cancer patients, 72% had experienced such an early psychic trauma. Only 10% of a non-cancerous control group reported such an experience. Name the independent variable and dependent variables and at least one extraneous variable that should have been controlled.