Lecture Notes

# Chapter 1: Introduction to Statistics

## Chapter Summary

Firmly based in the research process, statistics is described as one portion of the larger research process. The idea that statistics are already part of students’ lives is presented, along with the idea that students will make use of statistics as they move toward conducting their own research. In order to situate statistics as one element within the research process, the scientific method is discussed. Specific attention is given to developing the research hypothesis and planning to collect data by considering sampling and measurement issues and different research designs. The difference between descriptive and inferential statistics is introduced. The important point that boundaries exist around statistical knowledge is made by discussing the distinction between the terms “support” and “prove.”

**What Is Statistics?**

* Statistics is a branch of math dealing with the collection, analysis, interpretation and presentation of numerical data
  + Many times there is an overemphasis on analysis, but all pieces are important

**Why Learn Statistics?**

* Statistics are part of daily life: examples including APGAR, SAT, personality testing
* Learn to read and interpret the results of statistical analyses
* Learn to analyze your own research: Conducting your own research is part of what is valued in the discipline. Learning the skills here will aid in that professional development
* Statistics can help you in your future career

**Introduction to the Stages of the Research Process**

**Developing a research hypothesis**

* Research hypothesis:
  + A statement regarding an expected or predicted relationship between variables
  + Variable: A property or characteristic that can take on different values
    - Examples of variables: gender differences, eyewitness interrogation, and parenting feeding practices
* Research hypotheses can come from a variety of sources:
  + Identifying a question or issue to be examined
  + Reviewing and evaluating relevant theories and research
* Research hypotheses identify variables
  + Research questions pose a question about the relationship between variables, whereas research hypotheses suggest an answer to that question.
  + Independent variable: the variable manipulated by the researcher
  + Dependent variable: the variable measured by the researcher
* Research hypotheses specify (as precisely as possible) the nature and direction of the relationship between the variables
  + Directional hypothesis vs. non-directional hypothesis

**Collecting data**

* Drawing a sample from a population
* Population: the total number of possible units or elements that could be included in a study
* Sample: a subset of the population used to represent the population
* Examples of populations and samples:
  + Population: college students; sample: college students enrolled in a statistics course
  + Population: registered voters; sample: registered voters in a particular district who agree to complete a phone survey
  + Population: people with depression; sample: people who have been diagnosed with depression and who are seeking treatment from a particular therapist

**Levels of measurement**

* Nominal: values differ in category or type
  + e.g.: political affiliation; Academic major
* Ordinal: values can be placed in order relative to other values
  + e.g.: small, medium, large; first, second, third
* Interval: values are equally spaced on a numeric continuum
  + e.g.: temperature in Fahrenheit
* Ratio: interval variables with a true zero point
  + e.g.: temperature in Kelvin; amount of money you have in your bank right now

**Selecting a method to collect data**

* Experimental research methods: test for causal relationships among variables
* To test for causality, researchers eliminate other explanations (confounds)
  + Exert control to keep the conditions the same except for the variable of interest
  + Use a control condition to have a comparison group
  + Randomly assign participants to either the experimental or control conditions so that we can assume the two groups start out equivalent
* Non-experimental research methods: measure naturally occurring relationships between variables
  + Quasi-experimental research: Missing the property of random assignment these studies compare naturally existing or previously formed groups. E.g., comparing different teaching methods in different statistics sections
  + Survey research: Obtains opinion or attitudinal research from a sample of participants that can be used to represent the population
  + Observational research: Systematic observation of naturally occurring behaviors. Especially useful when behavior cannot or ethically should not be manipulated by an experimenter.
  + Archival research: Re-examining records or documents that may not have been originally intended to be data sources (e.g., examining the Top 40 list for changes in pronoun usage in song titles)
  + Labelling variables in non-experimental research: Some variables in non-experimental research are variables that cannot or were not manipulated. To avoid confusion, researchers sometimes refer to the independent variable and the dependent variable in a non-experimental study as the predictor variable and criterion variable, respectively.

**Analyzing the Data**

* Two main purposes of analyzing data:
  + **Descriptive statistics:** Organize, summarize and describe the data that has been collected
    - This will be the next topic tackled.
  + **Inferential statistics:** Test and draw conclusions about ideas and hypotheses
    - Making use of the foundation of descriptive statistics, you’ll learn how to generalize from samples to the population.

**Drawing a Conclusion Regarding the Research Hypothesis**

* Ask whether or not the results **support** the research hypothesis
  + There is an important distinction between **support** and **prove**

**Communicating the Findings of the Study**

* Communicating the results and interpretation of the results is important within the field

**Plan of the Book**

* Understand statistics within the context of the research process
  + Foundations of statistical analyses: descriptives
  + Assumptions underlying inferential statistics
  + Inferential statistics, and issues surrounding the use of the inferential techniques

**Summary**

* Statistics may be defined as a branch of mathematics dealing with the collection, analysis, interpretation, and presentation of masses of numerical data.
* Researchers conduct research using the scientific method of inquiry, a method of investigation that uses the objective and systematic collection and analysis of empirical data to test theories and hypotheses.
* A research question is posed, and hypotheses are made about the proposed relationships between the variables of interest.
* Data is collected from a sample of the population using either experimental or non-experimental research.
* Once data have been collected, the data is analyzed, and the analyses are interpreted regarding whether they support or not support the study’s research hypothesis.