

Chapter 1: Introduction to Statistics

OK, I told you that this is a course in communication. Like any language course, you're going to have to learn to speak the language. Prepare to master a lot of jargon!

Datum	A single measurement or observation, commonly called a score or a raw score.
Data	Plural of datum, measurements or observations
Data set	Collection of measurements or observations

Population	Sample
The set of all the individuals of interest in a particular study.	A set of individuals selected from a population, usually intended to represent the population in a research study.
A <i>parameter</i> is a value that describes a population. (Greek letter: σ , ρ)	A <i>statistic</i> is a value that describes a sample. (English letter: s , r)

Define a population that you might want to study.	
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Random sampling	A process for obtaining a sample from a population that requires that every individual in the population has the same chance of being selected for the sample.
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What procedure would you use to obtain a sample from your population so that it would be representative?	
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One is rarely interested in simply describing a sample, but if that were all that you want to do, you would compute *descriptive statistics* (procedures used to summarize, organize, and simplify data). It's much more common for one to be interested in using the sample to make inferences about the population. *Inferential statistics* consist of techniques that allow us to study samples and then make generalizations about the populations from which they were sampled.

Why would you select a sample? Why not just collect data from the entire population?	
Could you compute inferential statistics on a population? Why or why not?	

Sampling error is the discrepancy, or amount of error, that exists between a sample statistic and the corresponding population parameter. Obviously, you would do your best to minimize sampling error, but you should recognize that any inference is going to be imprecise.

Conducting Research in Psychology

A *variable* is a characteristic or condition that changes or has different values for different individuals. The *independent variable* (IV) is the variable that is manipulated by the researcher. The *dependent variable* (DV) is the one that is observed for changes in order to assess the effect of the treatment. You should think of the relationship between IV and DV as an “if...then” sort of relationship. If I do this (IV₁) then this happens (DV), but if I do that (IV₂) then something else happens (DV).

A *constant* is a characteristic or condition that does not vary, but is the same for every individual.

With the *correlational method*, two variables are observed to see if there is a relationship. As we’ll see when we get to Chapter 16, it’s extraordinarily difficult to infer causality based on correlational data. Can you figure out why?

In the *experimental method*, one variable (or more than one variable) is manipulated while changes are observed in another variable. To establish a cause-and-effect relationship between the two variables, an experiment attempts to eliminate or minimize the effect of all other variables by using *random assignment* and by *controlling* or *holding constant* other variables that might influence the results.

A *confounding variable* is an uncontrolled variable that is unintentionally allowed to vary systematically with the independent variable. You may be aware of the GIGO (Garbage In -> Garbage Out) Principle. When a study is confounded, it is no longer easily interpretable. Your book gives an example of a confounded study (e.g., Figure 1.5). In that example, the IV is the way in which information is delivered (*Lecture Only* vs. *Lecture with Lab*). However, Professor Smith delivers the *Lecture Only* condition and Professor Jones delivers the *Lecture with Lab* condition. You should always be on the alert for confounded studies! But you need to be able to fix confounded studies in addition to detecting them. How would you fix this confounded study?



A *hypothesis* is a prediction about the relationship between variables. In the context of an experiment, a hypothesis makes a prediction about how the manipulation of the IV will affect the DV. In order to be useful, of course, a hypothesis must be testable.

Constructs are hypothetical concepts that are used in theories to organize observations in terms of underlying mechanisms. What are some examples of constructs?

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An *operational definition* defines a construct in terms of specific operations or procedures and measurements that result from them. Thus, an operational definition consists of two components: First, it describes a set of operations or procedures for measuring a construct. Second, it defines the construct in terms of the resulting measurements. Typically, operational definitions are quite different from dictionary definitions. How might you operationally define some constructs?

Construct	Operational Definition
empathy	
promiscuity	

Scales of Measurement

Scale	Definition	Example
Nominal	Measurements on a nominal scale label and categorize observations, but do not make any quantitative distinctions between observations.	gender: male, female numbers on athletes' uniforms
Ordinal	Measurements on an ordinal scale rank observations in terms of size or magnitude.	IQ? Mho's scale of hardness
Interval	Categories are intervals of exactly the same size. With an interval scale, equal differences between numbers on the scale reflect equal differences in magnitude. However, ratios of magnitudes are not meaningful.	IQ? temperature in Fahrenheit
Ratio	A ratio scale is an interval scale with an absolute zero point.	count (0 = none, etc.) time temperature in Kelvin

The concept of scales of measurement is a complex one. First of all, keep in mind that the construct of interest is what is being measured. Thus, although I might use reaction time (with millisecond accuracy) to assess mental processing time, I cannot be certain that I'm using a ratio scale (even though time is a ratio scale). The reason is that I cannot actually observe the mental processes, so I can't be sure that all 732 milliseconds (for instance) were used to process the information.

Most statisticians don't believe that the scale of measurement should have an impact on the statistic that one chooses for an analysis, but there is some controversy surrounding this issue. And given that it's difficult to determine that any psychological constructs are measured at better than an ordinal level, we'd best hope that the statistical options aren't greatly constrained.

A *discrete variable* consists of separate, indivisible categories. No values can exist between two neighboring categories.

For a *continuous variable*, there are an infinite number of possible values that fall between any two observed values. A continuous variable is divisible into an infinite number of fractional parts.

For a continuous variable, each score actually corresponds to an interval on the scale. The boundaries that separate these intervals are called *real limits*. (See Figure 1.7)

Computation

Order of Mathematical Operations

1. Any calculation within parentheses is done first.
2. Squaring (or raising to other exponents) is done second.
3. Multiplying and/or dividing is done third (from left to right).
4. Summation (Σ) is done next.
5. Finally, addition and/or subtraction is done.