Statistical Studies: Statistical Investigations **Name _____**

III.A Student Activity Sheet 1: Overview of Purpose, Design, and Studies

Music is a large part of many people's lives. Because of this, it is often the subject of study. For example,

- Music industry executives want to know what will be popular with different age groups.
- Advertisers want to know which radio stations are the most popular.
- Doctors want to know how much hearing damage results from loud music.
- Teachers want to know whether or not listening to classical music helps students perform better on tests.

Statistical investigations are used every day for a variety of reasons.

1. What are the purposes of statistical investigations? Give some examples of statistical investigations with which you are familiar.

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_____

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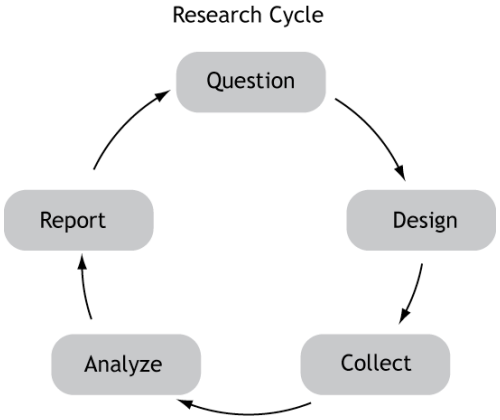


This graphic illustrates the process of planning and implementing a statistical investigation. First, a question (or a series of questions) sparks the interest of a researcher. The research team then decides on the best design for investigating the question.

2. The graph shows no obvious ending point (or starting point). What does this mean?

_____

_____

_____

_____

_____

Consider the following examples of two different types of statistical investigations.

Example 1

Radio rating services sometimes collect data on listenership by asking participants to record the date, time, and station each time they listen to the radio. Other rating services distribute monitoring devices that automatically record this information anytime the participant has the radio turned on. Still others call participants and ask them about their listening habits. The data are then compiled so that advertisers know which stations are the most popular at specific times during the day.

Each of these approaches is an example of an **observational study**, which collects data about some characteristic(s) of the population. The data can be collected by observation, by a survey or interview, or by other means.

3. Describe an observational study in your own words:

An observational study is research in which

_____
_____
_____
_____
_____

Example 2

*A 17-year-old student designed a science fair project with 72 mice randomly assigned to three groups: hard rock music, Mozart, and no music at all (called a **control group**). The mice in the first two groups were exposed to music 10 hours a day. Three times a week, all of the groups were timed as they ran through a maze. An analysis of results showed that the 24 mice in the no-music group averaged about a 5-minute improvement in their maze completion time, while the Mozart mice improved 8.5 minutes. The hard rock mice actually got slower—an average of four times slower! Another interesting fact: The student had to start his experiment over because all the hard-rock mice killed each other. None of the classical mice did that.* (Wertz, M. [1998]. *Why classical music is key to education.* from www.schillerinstitute.org/programs/program_symp_2_7_98_tchor_.html#Music_Mice_Mazes)

This is an example of an **experimental study**. In an experimental study, the researcher separates the participants into one or more groups and applies some sort of treatment. After treatment, the variable of interest is measured and the results are compared.

4. What are the **treatment** and the **variable of interest** in this case?

The treatment is _____

The variable of interest is _____

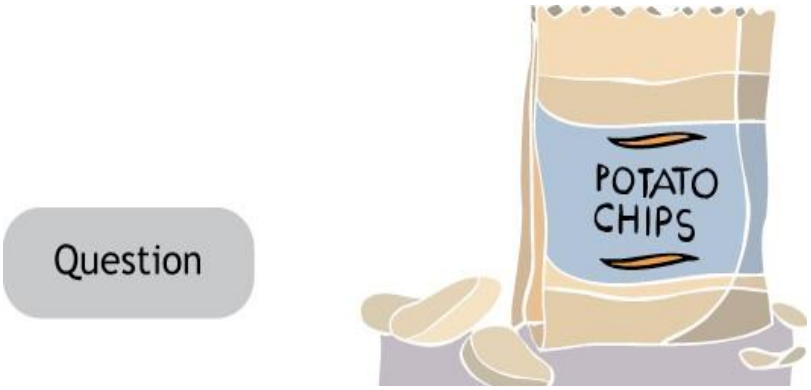
5. Describe an experimental study in your own words:

An experimental study is research in which _____

_____
_____
_____
_____

Observational and experimental studies have many components that must be planned, such as sampling and data collection procedures. Then the data must be collected, the results analyzed, and the conclusions reported.

6. Referring back to the Research Cycle graphic, why is there an arrow after the Report box?



And what about the Question box? Consider this situation: "This unopened bag of chips is half empty. I wonder if it really contains 28.3 grams as the package says?"

This type of informal question or observation is the beginning of many investigations. Informal questions can turn into more formal problem statements or **research questions**. For example, you may decide to investigate whether there is a scandal in the potato chip industry by checking the following:

"Do Spud Potato Chips contain an average of 28.3 grams of chips per bag?"

7. REFLECTION: Now that you have been introduced to the research cycle process, think of three research questions that you are interested in studying. List at least three ideas of research questions. Consider the following:

- **What type of study (experimental or observational) might be best to approach each of your research questions?**
- **If you only have four weeks to actually implement a research study, is it still possible to study any of your research questions?**

1. _____
   Type of study _____ Is 4 weeks long enough? _____

2. _____
   Type of study _____ Is 4 weeks long enough? _____

3. _____
   Type of study _____ Is 4 weeks long enough? _____

How can you change one of your questions to make it fit into this timeline?

_____

8. Suppose you conduct the investigation into Spud Potato Chips and find that the mean weight of the chips in your sample is 25 grams, rather than 28.3 grams ($\bar{x}$ = 25 grams). Do you think that a difference of 3.3 grams between the actual and advertised weights is large enough that it needs to be reported? If so, how do you report this information and to whom

In some situations, researchers are even more formal and state **hypotheses.** In a case like this, the **null hypothesis** (H_o) generally states that there is no difference between the true value and the claimed value. The **alternative hypothesis** (H_a) states that something is different or incorrect, or that something has changed.

9. What are the null and alternative hypotheses for the potato chip example?

- H_o: The true mean weight _____
- H_a: The true mean weight _____

Notice that the hypotheses say "The true mean weight." This implies that the statements refer to the **population** of all Spud Potato Chip bags, not just a single bag or even a small sample. When a statistical investigation is conducted, it generally employs a sample that is then used to make a generalization about the population. Notice that in this case (as in many cases), *population* does not refer to people, but to bags of potato chips.

To be concise, researchers often use symbols in place of words. Greek letters are usually used when referring to populations (the entire group being studied, from which a sample or samples will be drawn). English letters are used for samples (the particular items or individuals included in a particular study). For example, when discussing the mean:

- μ = the population mean (Greek letter *mu*—pronounced *mew*)
- $\bar{x}$ = the sample mean (pronounced ***x****-bar*)

So the hypotheses for a study can be stated in words or symbols. When using symbols, you must identify what your symbols represent.

- H_o: $\mu \geq 28.3$ grams, where μ is the true mean weight of a bag of Spud Potato Chips
- H_a: $\mu < 28.3$ grams

Statistical studies are designed with carefully selected measures that ensure (within error margins) that, if the sample is well selected and the study is well designed and conducted, the mean and other measures of the sample are likely to be similar to the corresponding measures of the population being studied. Sometimes, if the population is small (such as high school seniors in a small town), it may be possible that the sample studied is the entire population. However, often a sample is a smaller subset of a population (such as a research question that might target the entire population of high school seniors in a state or in the nation)