**Day 02 - Warm-Up Name \_\_\_\_KEY\_\_\_\_\_\_\_\_\_\_**

For each of the following studies, first decide if it is an experimental study or an observational study.

* If it is experimental, answer the following questions:
1. Who/what are the participants?
2. What is the treatment?
3. How was the treatment assigned?
4. What is the control group?
* If it is an observational study, answer the following questions:
1. Who/what are the participants?
2. What is being observed?

1. A professor wants to study the effects that teaching outdoors has on test scores. Each individual in the study is given the same lectures for a month and then tested. His first class of the day meets inside and his second class of the day meets outside.

Experimental

* Participants – the Professors 1st and 2nd period classes
* Variable of interest – effects of having class outside have on test scores
* Treatment – having class outside
* Treatment assigned based on class period
* Control Group – class inside

2. A company conducts a study to determine whether college students suffer from math anxiety. Students are asked to wear a heart rate monitor while taking their math midterm and data is collected. The company claims that if math anxiety is not present then the student’s heart rate should not change by more than 10 beats per minute.

Observational

* Participants – college math students
* Variable of interest – math anxiety in college students
* Observed – heart rate when taking their math test to collect data on math anxiety. Do they have a high number of beats per minute?

**SAS 3A.1 – Overview of Purpose, Design and Statistical Studies - Day 2 Name: \_\_\_KEY\_\_\_\_\_\_**

1. 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 ($\overline{x}$ = 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 think that you report this information and to whom?

I believe this needs to be reported – I want the chips I’m paying for! I could write a letter of complaint to the president of the chip company or advertise in the local newspaper or post my disappointment on social media, etc. You could report this information in a variety of mediums – just depends on the group you are trying to reach the most.

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

2. What are the null and alternative hypothesis for the potato chip example?

Ho: The true mean weight of bags of spud potato chips is 28.3 grams or greater.

Ha: The true mean weight of bags of spud potato chips is less than 28.3 grams.

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 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.

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:

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

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

* $H\_{0}: μ \geq 28.3 grams, where μ is the true mean weight of a bag of Spud Potato Chips$
* $H\_{0}: μ<28.3 grams$

***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, 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).***

***Practice writing hypotheses. Write them in words and then convert them to symbols. Sketch or outline a simple study design that might help study the hypotheses.***

3. A local pizza shop advertises “an average delivery time of 20 minutes or less”, but it does not offer a guarantee such as a free pizza. The national manager, Su Lin, wonders if her employees are fulfilling the claim.

H0:  Null Hypothesis: the true mean delivery time is 20 min or less.

Ha:  Alternative Hypothesis: the true mean delivery time is greater than 20 min.

Su Lin can check the records at shops around the country for actual delivery times, collect the data, average the delivery times, and analyze the reports. Or she might hire “secret shoppers” who record the time they call in their orders and the time they receive their pizzas.

4. A water quality control board reports that water is unsafe for drinking if the mean nitrate concentration exceeds 30ppm. Water specimens are taken from a well.

H0:  Null Hypothesis: the mean nitrate concentration of water is 30 ppm or less.

Ha:  Alternative hypothesis: the mean nitrate concentration of water exceeds 30 ppm.

You could test the water in multiple wells to see how the nitrate concentration compares in different areas OR could test the same well multiple days to see if the nitrate concentration remains the same.

5. Researchers have postulated that, due to difference in diet, Japanese children have a lower mean blood cholesterol level than U.S. children. Suppose that the mean level of U.S. children is known to be 170.

H0:  Null Hypothesis: the mean blood cholesterol level of Japanese children = that of U.S. children

Ha:  Alternative Hypothesis: the mean blood cholesterol level of Japanese children is different from that of U.S. children.

Researchers could measure children’s cholesterol levels and give them a survey on their eating habits/diet. They could then analyze the results and draw a conclusion about their findings.

6. Census Bureau data show that the mean household income in the area surveyed by a shopping mall is $42,500 per year. A market research firm questions shoppers at the mall. The researchers suspect that mean household income of mall shoppers is higher than that of the general population.

H0:  Null Hypothesis: mean household income of mall shoppers is $42,500/year or less.

Ha:  Alternative Hypothesis: mean household income of mall shoppers is greater than $42,500

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Day 2

**Ticket out the Door**

1. Compare and Contrast experimental and observational studies.
2. What is the purpose of writing a hypothesis? What situations would require a hypothesis to be written?
3. State the null and alternative hypotheses for the following study.

You want to study the ability of students to talk at a normal tone while listening to loud music with their MP3 player headphones. You measure how loud a student talks normally, then you measure how loud the student talks while listening to loud music with their MPS player headphones. You believe that a student will not be able to talk at a normal tone while listening to loud music.

**SAS 3A.1 –Day 2 – Homework Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

For each of the followings studies, first decide if it is an experimental study or an observational study.

|  |  |
| --- | --- |
| If it is experimental, answer the following questions: | If it is an observational study, answer the following questions: |
| 1. Who/what are the participants?
2. What is the treatment?
3. How was the treatment assigned?
4. What is the control group?
 | 1. Who/what are the participants?
2. What is being observed?
3. What is the null hypothesis?
4. What is the alternative hypothesis?

Write hypotheses in words and symbols. |

A. A researcher conducts a survey to determine the approval rating of the current mayor of a city. He surveys registered voters in the mayor’s district. The researcher wants to determine if the mayor’s approval rating is more than 60%.

B. A company conducts an experiments to determine whether the use of educational software in an elementary classroom will increase test scores of students. One 3rd grade class is given the software and another 3rd grade class is not given the software. The company then looks at the average test scores for both classes.

C. A manager wants to study the effects that positive reinforcement has on an employee’s willingness to work overtime. At random, one group of employees is given no reinforcements, while another group is given positive reinforcement during their weekly meeting with the manager.

Recall the potato chip hypothesis from class. What would you do next to determine which of these hypotheses is true?