**Quiz 5, Version 1**

**Scenario 1**: Since 2006, millions of bats in North American have died due to infection with a fungus that causes a disease called white-nose syndrome. Researchers hoping to conserve bats have developed an anti-fungal treatment that kills the fungus in petri dishes in the lab. Now they want to try the anti-fungal treatment on hibernating bats, to determine whether using the anti-fungal treatment on bats **increases** mean bat survival during hibernation relative to control bats that are not treated. They pick 10 caves in Michigan for their experiment. In each cave, they randomly select 20 little brown bats to apply their anti-fungal treatment to and 20 little brown bats to serve as controls.

Q1. Which of these hypotheses are the researchers testing in Scenario 1?

1. H0: µtreatment - µcontrol = 0

Ha: µtreatment - µcontrol > 0

1. H0: µtreatment - µcontrol = 0

Ha: µtreatment - µcontrol ≠ 0

1. H0: µtreatment - µcontrol < 0

Ha: µtreatment - µcontrol ≠ 0

1. H0: µtreatment = 5

Ha: µtreatment ≠ 5

Q2. After they complete their study in Scenario 1, the researchers run a t-test, which gives them a p value of 0.03. Using α=0.05, which of these conclusions is **not** correct?

1. Because their p value is small, they fail to reject the null hypothesis.
2. The probability that they could have collected their dataset if the null hypothesis was true is small (the p value is small).
3. They can infer that treated bats have significantly higher survival than control bats.
4. Because their p value is less than 0.05, they should reject the null hypothesis.

Q3. What type of study and statistics does Scenario 1 represent?

1. This is a manipulative experiment and the researchers are using inferential statistics to draw conclusions about a population.
2. This is a manipulative experiment and the researchers are using descriptive statistics to describe a population.
3. This is an observational study and the researchers are using inferential statistics to draw conclusions about a population.
4. This is an observational study and the researchers are using descriptive statistics to describe a population.

Q4. Which of these statements is **not** correct?

1. In this example, the statistical power is low, because the sample size is large.
2. In this example, a Type I Error would mean concluding that treated bats had higher survival than control bats, even though they did **not** truly have higher survival.
3. In this example, a Type II Error would mean concluding that treated bats did **not** have higher survival than control bats, even though they truly had higher survival.
4. In this example, statistical power would mean the ability to detect a difference in survival between treated and control bats, if mean survival was truly different between the two groups.

Q5. The researchers submit their study for publication in a science journal, and a peer reviewer is worried that the bats in each cave might **not** be **independent** experimental units, which would cause a pseudoreplication issue in the study design. Which of these statements is **false**?

1. The researchers could solve this pseudoreplication issue by re-doing their study in the same 10 caves, but this time increase the number of replicates in each cave (e.g., n=100 bats per treatment group in each of 10 caves).
2. If bats within a cave are independent experimental units, the total number of replicates per treatment group is 200 bats (20 bats x 10 caves).
3. If bats within a cave are not independent experimental units, the total number of replicates per treatment group is more like 10 bats (1 replicate per cave \* 10 caves), and that sample size is not big enough to meet the Law of Large Numbers requirement for many statistical analyses.
4. Bats within a cave might not be independent experimental units because something that happens inside a cave during hibernation could affect all of the bats at once; for instance, if a raccoon visits a cave during hibernation and eats some bats, every bat in the cave might become stressed out.

Q6. Which kind of experimental design did the researchers use?

1. A randomized block design, where caves were blocks and bats were experimental units/replicates; all bats in a cave were equally likely to be included in the study; and bats were randomly assigned to treatment groups.
2. A simple random design, where all bats in Michigan were equally likely to be included in the study; bats were experimental units/replicates; and bats were randomly assigned to treatment groups.
3. A systematic design, where bats were experimental units/replicates; and bats in the two treatment groups were evenly spaced throughout each cave.
4. A segregated design, where bats were experimental units/replicates; and all bats on the ceiling were assigned to the treatment group and all bats on the walls were assigned to the control group.

**Quiz 5, Version 2**

**Scenario 2**: In 2017, more than 4000 people attempted to thru-hike the entire Appalachian Trail. When planning to thru-hike the entire Appalachian Trail, people really want to know exactly how many miles they will be hiking. But the official estimates that can be found online vary from about 2,100 miles to 2,200 miles. So let’s say that the Appalachian Trail Conservancy decides to do a study where they put out a request via social media for every hiker planning to thru-hike the entire Appalachian Trail in 2020 to contact them. From a list of 3,200 people who responded to their social media request, they randomly select 50 hikers and mailed them fancy GPS exercise trackers to use during their thru-hike. The GPS exercise trackers measure exactly how far a person walks each day using satellite GPS technology. The Appalachian Trail Conservancy thinks that the trail is 2,190 miles long in 2020, but will test this hypothesis using the GPS tracker data.

Q1. Which of these hypotheses is the Appalachian Trail Conservancy testing in Scenario 2?

1. H0: µtraillength = 2190 miles

Ha: µtraillength ≠ 2190 miles

1. H0: µtraillength = 0 miles

Ha: µtraillength > 0 miles

1. H0: µtraillength = 0 miles

Ha: µtraillength ≠ 0 miles

1. H0: µtraillength = 2190 miles

Ha: µtraillength > 2190 miles

Q2. After they complete their study in Scenario 2, the Appalachian Trail Conservancy runs a t-test, which gives them a p value of 0.80. Using α=0.05, which of these conclusions is **not** correct?

1. The length of the Appalachian Trail is greater than 2190 miles.
2. The probability that they could have collected their dataset if the null hypothesis was true is large (the p value is large).
3. The length of the Appalachian Trail is not statistically different from than 2190 miles.
4. Because their p value is large, they fail to reject the null hypothesis.

Q3. What type of study and statistics does Scenario 3 represent?

1. This is an observational study and the researchers are using inferential statistics to draw conclusions about a population.
2. This is a manipulative experiment and the researchers are using inferential statistics to draw conclusions about a population.
3. This is a manipulative experiment and the researchers are using descriptive statistics to describe a population.
4. This is an observational study and the researchers are using descriptive statistics to describe a population.

Q4. Which of these statements is **not** correct?

1. In this example, our statistical power is low, because we do not have a sample of more than 100 thru-hikers.
2. In this example, a Type I Error would mean concluding that the Appalachian Trail is **not** 2190 miles long, even though it **is** 2190 miles long.
3. In this example, a Type II Error would mean concluding that the Appalachian Trail **is** 2190 miles long, even though the Appalachian Trail is **not** 2190 miles long.
4. In this example, statistical power would mean the ability to detect that the Appalachian Trail is not 2190 miles long, if the Appalachian Trail is truly not 2190 miles long.

Q5. Which of these is **not** a bias in the study designed by the Appalachian Trail Conservancy?

1. They only included hikers who were hiking the Appalachian Trail in 2020.
2. They only included hikers who use social media.
3. They only included hikers who had time to respond to the request.
4. They only included hikers who had a physical address where they could receive mail.

6. Which kind of study design did the Appalachian Trail Conservancy use?

1. A simple random design, where all hikers who responded to the social media request were equally likely to be included in the study.
2. A randomized block design, where hiker age was a blocking variable, and all hikers in each age group who responded to the social media request were equally likely to be included in the study.
3. A systematic design, where the first hiker from each state to respond to the social media request was included in the study.
4. A convenience design, where the Appalachian Trail Conservancy gave the GPS trackers to any hikers that lived in places with shipping costs were less than $2.