

1. For each of the following scenarios, identify the name of the procedure for constructing a confidence interval, and then define the parameter of interest.
 - a. A psychologist wants to know if meditation or exercise works better for reducing stress. A random sample of patients is asked to meditate consistently for one month and exercise regularly for another month, with the order randomized. At the end of each month, they will complete a survey on which they rate their stress levels on a scale of 1 to 10.
 - b. A track coach is considering two different offseason weight training programs for the sprinters on the team. She randomly assigns half of the sprinters to do heavy weight lifting 3 days a week and the other half of the sprinters to do light weight lifting 6 days a week. After two months of training, each of the sprinters will run a 100-meter sprint and their time will be recorded.
 - c. A market analyst who works at Netflix selects a random sample of 200 Netflix subscribers and asks them to rate their satisfaction with the Netflix app on a scale from 1 to 5.

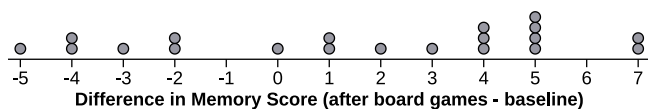
2. A local coffee shop wants to determine if customers prefer the flavor of their cappuccino with oat milk or regular milk. They are considering the following two experiments with 40 volunteers available for taste testing:

Experiment 1: Half of the volunteers will be randomly assigned to drink a cappuccino with oat milk and the other half to drink a cappuccino with regular milk. Each of the volunteers will rate the cappuccino on a flavor scale from 1 to 10.

Experiment 2: Each volunteer drinks one cappuccino with oat milk and another with regular milk and the order is randomized. They will then rate the flavor of each drink on a scale from 1 to 10.

- a. Which experiment (1 or 2) is a completely randomized experiment? Explain your reasoning.
- b. Define the parameter of interest for this experiment.
- c. Which experiment (1 or 2) is a matched pairs experiment? Explain your reasoning.
- d. Define the parameter of interest for this experiment.

3. A doctor who works with Alzheimer's patients was interested in determining if playing board games would help her patients with memory. For 20 volunteer patients, she measured their baseline memory score and then their memory score after six months of playing board games at least 3 times per week. Here is the distribution of differences in memory score (after board games – baseline) for each of the 20 patients:



- a. What is the meaning of differences that are positive?
- b. What percent of the differences show an improvement in memory scores?
- c. A 95% confidence interval for the true mean difference in memory score is $(-0.15, 3.45)$. Based on this interval, is there convincing statistical evidence that memory scores improve after 6 months of playing board games for Alzheimer's patients like these? Explain your reasoning.

4. A history teacher wonders if students taking notes digitally on a computer would improve test scores compared to taking hand-written notes.

Scenario 1: The teacher recruited 5 students to volunteer for an experiment. Each student was required to take hand-written notes for one unit and notes on a computer for another unit. Here are the results:

Unit test scores					
Student	1	2	3	4	5
Hand-written notes	93	87	78	73	85
Notes on a computer	98	91	78	65	88

Scenario 2: The teacher recruited 10 students to volunteer for an experiment. For one unit, half of the students were randomly assigned to take hand-written notes and the other half took notes on a computer. Here are the results:

Unit test scores					
Hand-written notes	93	87	78	73	85
Notes on a computer	98	91	78	65	88

- a. For Scenario 1, would it make sense to subtract the values in the first column of the table ($98 - 93$) . Explain.
- b. For Scenario 1, would the teacher calculate a mean difference or a difference in means?
- c. For Scenario 2, would it make sense to subtract the values in the first column of the table ($98 - 93$) . Explain.
- d. For Scenario 2, would the teacher calculate a mean difference or a difference in means?

5. In a recent study conducted by Stanford Medicine researchers, 22 pairs of identical twins were recruited to participate in a food study that investigated the effects of a vegan diet (a plant-based diet with no food derived from animals). For each pair of twins, one of them was randomly assigned to eat a vegan diet for 8 weeks, while the other ate a conventional omnivore diet. At the end of the 8 weeks, each subject had a blood test and their cholesterol level was recorded. For each pair of twins, the difference in cholesterol level (vegan diet – omnivore diet) was calculated. The distribution of differences was fairly symmetric with no outliers and had a mean of -13.9 mg/dL and a standard deviation of 25.8 mg/dL.
- a. Construct and interpret a 95% confidence interval for the true mean difference of cholesterol level for pairs of twins like the ones in the study.
- b. Based on the confidence interval, do the researchers have convincing statistical evidence that a vegan diet reduces cholesterol levels? Explain.
6. A meteorologist wants to estimate the average temperature increase between winter and summer in the United States. She randomly selects 30 cities in the United States and looks up the average temperature on January 1 and July 1 for each city. Which of the following is the most appropriate inference procedure?
- A) one-sample z -interval for a population proportion
- B) two-sample z -interval for a difference in population proportions
- C) one-sample t -interval for a population mean difference
- D) two-sample t -interval for a difference in population means

7. A company that reviews new tech products gets a random sample of a new batch of fitness trackers. They want to determine if battery life depends on the type of fitness activity. Ten athletes were recruited to use an activity tracker for one full week while only doing running and to use the same activity tracker for a different full week while only doing biking. The decision for which week would be running was determined at random. Which of the following statements is correct?
- A) This experiment is a completely randomized design because the fitness trackers were randomly selected.
 - B) This experiment is a completely randomized design because order of the two fitness activities was determined randomly.
 - C) This experiment is a matched pairs design because each athlete is paired with a fitness tracker.
 - D) This experiment is a matched pairs design because each athlete received two treatments (running and biking).