1. How do you control for biases?

Randomization: Ensuring participants are randomly assigned to different groups helps in balancing out unknown factors across these groups.

Blinding: Keeping participants, researchers, or analysts unaware of the group assignments prevents their expectations or behaviors from influencing the outcomes.

Matching: Pairing participants in different groups based on similar characteristics (like age, gender, etc.) helps control for those variables.

Statistical Controls: Using statistical methods to adjust for the effects of confounding variables.

Validation: Use of external data to validate findings helps ensure the results aren't due to biased or erroneous data.

Repetition and Replication: Repeating studies or having findings replicated by independent researchers strengthens the validity of the results by confirming they are not due to random chance or biased methods.

2. What are confounding variables?

Confounding variables are factors other than the independent variable that might affect the dependent variable in a study, potentially leading to incorrect conclusions. These variables are associated both with the dependent variable and the independent variable, causing a mixing of effects that can make it difficult to isolate the impact of the independent variable.

3. What is A/B testing?

A/B testing is a statistical method used to compare two versions of a variable (typically web pages, products, or user interfaces) to determine which one performs better on a given metric. This involves running a controlled experiment where two variants, A (the control) and B (the test), are shown to different segments of users at random, and statistical analysis is then used to determine which version is more effective in terms of predefined metrics.

4. When will you use Welch t-test?

The Welch t-test is used when comparing the means of two groups that may have unequal variances and possibly unequal sample sizes. This test is an adaptation of the Student’s t-test and is more reliable when the assumption of equal variances is not met. It’s particularly useful when dealing with real-world data where the assumption of equal variances between groups is often violated.

5. Testing the claim about customer service call duration

To test whether the average time customer service representatives spend on the phone is significantly higher than the company claims (6 minutes), we can use a one-sample t-test. The hypothesis would be:

Null Hypothesis (H0): The average call time, μ, is 6 minutes.

Alternative Hypothesis (H1): The average call time, μ, is greater than 6 minutes.

from scipy.stats import t

t\_statistic = (sample\_mean - population\_mean) / (sample\_std / (sample\_size \*\* 0.5))df = sample\_size - 1

p\_value\_one\_tailed = t.sf(t\_statistic, df)

t\_statistic, p\_value\_one\_tailed

result: (2.946278254943948, 0.0024555744280253798)

6. Testing the difference in mean scores between two groups

For the scenario where two groups of students are tested for differences in their math test scores, we can use an independent two-sample t-test, likely the Welch t-test given the unequal variances and potentially unequal sample sizes:

Null Hypothesis (H0): There is no difference in the average scores between the two groups (μ₁ = μ₂).

Alternative Hypothesis (H1): There is a difference in the average scores (μ₁ ≠ μ₂).

import numpy as np

mean\_a, std\_a, n\_a = group\_a\_scores['mean'], group\_a\_scores['std'], group\_a\_scores['n']

mean\_b, std\_b, n\_b = group\_b\_scores['mean'], group\_b\_scores['std'], group\_b\_scores['n']

t\_statistic = (mean\_a - mean\_b) / np.sqrt((std\_a\*\*2/n\_a) + (std\_b\*\*2/n\_b))

df = (((std\_a\*\*2/n\_a) + (std\_b\*\*2/n\_b))\*\*2) / \

(((std\_a\*\*2/n\_a)\*\*2 / (n\_a-1)) + ((std\_b\*\*2/n\_b)\*\*2 / (n\_b-1)))

p\_value = t.sf(np.abs(t\_statistic), df) \* 2 # Multiplied by 2 for two-tailed test

t\_statistic, p\_value, df

result: (-1.4650132801342768, 0.14941450596390296, 48.16767771755786)