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1. How do you control for biases?

We start by assuming that the current understanding is correct, rather than if our new hypothesis is. For example, rather than testing if someone is drunk driving, we assume they are sober, with the alternative hypothesis being they aren't sober. This is called Null Hypothesis Significance Testing. When testing on a group, random assignment is used, to destroy pre-existing systematic relationships. We test for statistical significance and say that something is NOT statistically significant if there is a less than 5 percent chance that our finding was caused by chance alone (assuming the null hypothesis is true).

2. What are confounding variables?

In a cause-and-effect study, a confounding variable is an unmeasured variable that influences both the supposed cause and effect.

3. What is A/B testing?
A/B testing—also called split testing or bucket testing—compares the performance of two versions of content to see which one appeals more to visitors/viewers. It tests a control (A) version against a variant (B) version to measure which one is most successful based on your key metrics.

4. When will you use Welch t-test?

The Welch's t-test, also known as Welch's unequal variances t-test, is a statistical test used to compare the means of two independent groups when the assumption of equal variances is violated. It is an adaptation of the Student's t-test that is robust to differences in sample variances and sample sizes between the two groups.

When the variances of the two groups are unequal, the standard Student's t-test may not provide accurate results. In such cases, Welch's t-test is preferred because it adjusts for the unequal variances by modifying the degrees of freedom used in the t-distribution.

5. A company claims that the average time its customer service representatives spend on the phone per call is 6 minutes. You believe that the average time is actually higher. You collect a random sample of 50 calls and find that the average time spent on the phone per call in your sample is 6.5 minutes, with a standard deviation of 1.2 minutes. Test whether there is sufficient evidence to support your claim at a significance level of 0.05.

Null Hypothesis: The population mean time is 6 minutes.
Alternative Hypothesis: The population mean time is greater than 6 minutes.

$x-\mu/S/\sqrt{n}$
$6.5-6/(1.2/\sqrt{50})$
$.5/0.169706$
2.9462717876798698926378560569455411122765252849044818686434186180
$t = 2.95$
$df = 49$
Critical value: 1.6766

Since the calculated t-statistic (2.95) is greater than the critical value (1.6766), you would reject the null hypothesis.

This outcome indicates that there's statistically significant evidence, at the 0.05 significance level, to support the claim that the average time customer service representatives spend on the phone per call is greater than 6 minutes.

Given these results, the hypothesis that the average call duration is longer than the company's claimed value of 6 minutes is supported.

6. A researcher wants to determine whether there is a difference in the mean scores of two groups of students on a math test. Group A consists of 25 students who received traditional teaching methods, while Group B consists of 30 students who received a new teaching method. The average score for Group A is 75, with a standard deviation of 8, and the average score for Group B is 78, with a standard deviation of 7. Test whether there is a significant difference in the mean scores of the two groups at a significance level of 0.05.

Group A:

- Sample mean ($\bar{x}_A$): 75
- Sample standard deviation (s_A): 8
- Sample size (n_A): 25

Group B:

- Sample mean ($\bar{x}_B$): 78
- Sample standard deviation (s_B): 7
- Sample size (n_B): 30

Null Hypothesis (H_0): There is no difference in the mean exam scores between Group A and Group B ($\mu_A = \mu_B$).

Alternative Hypothesis (H_1): There is a difference in the mean exam scores between Group A and Group B ($\mu_A \neq \mu_B$).

$t = (\bar{x}_A - \bar{x}_B) / \sqrt{(s_A^2/n_A + s_B^2/n_B)}$

$t = (75 - 78) / \sqrt{(8^2/25 + 7^2/30)}$
$t = (-3) / \sqrt{(2.56 + 1.63333)}$
$t = (-3) / \sqrt{(4.19333333)}$
$t = (-3) / 2.04776299898$
$t \approx -1.47$

$df = ((s_A^2/n_A) + (s_B^2/n_A))^2/ (((s_A^2/n_A)^2/(n_A-1) + ((s_B^2/n_B)^2/(n_B-1)))$
$df = ((8^2/25) + (7^2/30))^2/ (((8^2/25)^2/(25-1) + ((7^2/30)^2/(30-1)))$
$df = (4.19333333)^2/ (((2.56)^2/(24) + ((1.63333)^2/(29)))$
$df = (4.19333333)^2/ (.27306 + .09199)$
$df = 17.5840444165/.36505$
$df \approx 48$

Critical value: ±2.0106

Since the test statistic (-1.47) does not exceed the critical value (±2.0106), we fail to reject the null hypothesis.

There is not sufficient evidence to conclude that there is a significant difference in the mean exam scores between Group A and Group B at the 0.05 significance level