Week 7 - HW- Data Science Bootcamp

Q. How do you control for biases?

Controlling for biases involves various strategies depending on the type of study or data collection. Key approaches include:

- **Randomization:** Assign subjects randomly to different groups to equalise the influence of confounding variables across groups.
- **Blinding:** Keeping study participants, researchers, or both unaware of which interventions participants receive to prevent expectation biases.
- **Matching:** Pairing participants in experimental and control groups based on key variables such as age, gender, or other factors.
- **Statistical control:** Using statistical methods like regression to adjust for the effects of confounding variables.
- **Repetition and Replication:** Repeating experiments or studies to ensure that results are consistent over time and can be replicated by other researchers.

Q. What are confounding variables?

Confounding variables are factors other than the independent variable that might affect the dependent variable in a study, thereby potentially leading to incorrect conclusions. These variables are related both to the dependent variable and to the independent variable, and they can mask or falsely enhance the effects of the independent variable if not properly controlled.

Q. What is A/B testing?

A/B testing, at its most basic, is a way to compare two versions of something to figure out which performs better. It is commonly used in web development and marketing to compare two versions of a web page or app against each other to determine which one performs better on a specified metric. This is achieved by randomly serving either version A or version B to users, ensuring that each user sees only one version.

Q. When will you use the Welch t-test?

The Welch t-test is used when you want to compare the means of two groups and the variances and/or sample sizes of the groups are not equal.

Q. **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.**

Q5. Sample size = $n = 50$

Sample mean = $\bar{x} = 6.5$ mins

Sample std. dev = $s = 1.2$ mins

Population mean = $\mu = 6$ mins

$\alpha = 0.05$ (95% confidence level)

$H_0 = \mu = 6$

$H_A = \mu > 6$

$$S.E.M = \frac{s}{\sqrt{n}} = \frac{1.2}{\sqrt{50}} \approx 0.1697$$

$$\text{t-test} = t = \frac{\bar{x} - \mu}{SEM} = \frac{0.5}{0.1697} \approx 2.946$$

$df = n - 1 = 49$

p value $(t = 2.946,\ df = 49) = 0.0025$

$p < 0.05$ $\therefore$ we reject null hypothesis

$\therefore$ $\boxed{\text{avg time} > 6 \text{ mins}}$

theres sufficient evidence

Q6. 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.

6. Group A →

$n_A = 25$

$\bar{x}_A = 75$

$S_A = 8$

Group B →

$n_B = 30$

$x_B = 78$

$S_B = 7$

$\alpha = 0.05$

$H_0 = \mu_A = \mu_B$

$H_a = \mu_A \neq \mu_B$

$$SE_{pooled} = \sqrt{\frac{S_A^2}{n_A} + \frac{S_B^2}{n_B}}$$

$$= \sqrt{\frac{8^2}{25} + \frac{7^2}{30}} \approx 2.042$$

Welch T-Statistic → $t = \dfrac{\bar{x}_A - \bar{x}_B}{SE_P}$

$$= \frac{75 - 78}{2.042} \approx -1.965$$

$$df = \frac{\left(\frac{S_A^2}{n_A} + \frac{S_B^2}{n_B}\right)^2}{\frac{\left(\frac{S_A^2}{n_A}\right)^2}{n_A - 1} + \frac{\left(\frac{S_B^2}{n_B}\right)^2}{n_B - 1}} \approx 48.168$$

$t \approx -1.465$

$df \approx 48$

$p = 0.149$

$p > 0.05$ → we fail to reject H_0

not sufficient evidence