**Hypothesis Testing Assignment**

**1. Hypothesis Formulation: - A company claims that their new energy drink increases focus and alertness. Formulate the null and alternative hypotheses for testing this claim.**

Null Hypotheses (H0): The new energy drink has no effect on focus and alertness.

Alternate Hypotheses (H1): The new energy drink increases focus and alertness.

**2. Significance Level Selection: - A researcher is conducting a study on the effects of exercise on weight loss. What significance level should they choose for their hypothesis test and why?**

The significance level should be 0.05 or 5% which is a common value used in the industry. This means your results must have a 5% or lower chance of occurring under the null hypothesis to be considered statistically significant.

**3. Interpreting p-values: - In a study investigating the effectiveness of a new teaching method, the calculated p-value is 0.03. What does this p-value indicate about the null hypothesis?**

p-value < significance level (𝛼)

If the p-value is less than the significance level, it suggests that the observed results are statistically significant. In this case, p-value = 0.03, it means that there is sufficient evidence to reject the null hypothesis at the chosen significance level. This suggests that there is evidence to support the alternative hypothesis, indicating that the new teaching method is likely to have a significant effect compared to the null hypothesis (no effect).

**4. Type I and Type II Errors: - Describe a scenario in which a Type I error could occur in hypothesis testing. How does it differ from a Type II error?**

Let's imagine a scenario in a gaming context where we are testing a hypothesis about a player's skill level.

**Type I Error (False Positive):** Test wrongly leads us to reject the null hypothesis and conclude that the player is indeed cheating, when in fact, they were just exceptionally skilled.

Null Hypothesis (H0): The player's performance is due to legitimate skill.

Alternative Hypothesis (H1): The player's performance is due to cheating.

**Type II Error (False Negative)**: a Type II error would occur if the player actually was cheating, but our test failed to detect it.

Null Hypothesis (H0): The player's performance is due to legitimate skill.

Alternative Hypothesis (H1): The player's performance is due to cheating.

**5. Right-tailed Hypothesis Testing: - A manufacturer claims that their new light bulb lasts, on average, more than 1000 hours. Conduct a right-tailed hypothesis test with a significance level of 0.05, given a sample mean of 1050 hours and a sample standard deviation of 50 hours.**

Null Hypothesis (𝐻0​): The population mean (𝜇) of the light bulb lifespan is 1000 hours or less. 𝐻0: 𝜇 ≤ 1000

Alternative Hypothesis (𝐻1): The population mean (𝜇) of the light bulb lifespan is greater than 1000 hours. 𝐻1: 𝜇 > 1000

* Sample mean (𝑥ˉ) = 1050 hours
* Sample standard deviation (𝜎) = 50 hours
* Significance level (𝛼) = 0.05

calculating the z scores:

*z*=10 if we assume a sample size of 𝑛=100 for demonstration purposes.

The critical value for a right-tailed test at 𝛼=0.05is approximately 1.645.

Since 𝑧=10 is much greater than 1.645, we reject the null hypothesis (𝐻0​).

Thus, we have sufficient evidence to conclude that the population mean lifespan of the new light bulb is greater than 1000 hours, supporting the manufacturer's claim.

**6. Two-Tailed Hypothesis Testing: - A researcher wants to determine if there is a difference in mean exam scores between two groups of students. Formulate the null and alternative hypotheses for this study as a two-tailed test.**

Null Hypothesis (𝐻0​): There is no difference in mean exam scores between the two groups of students. 𝐻0: 𝜇1−𝜇2 = 0

Alternative Hypothesis (𝐻1​): There is a difference in mean exam scores between the two groups of students. 𝐻1: 𝜇1−𝜇2≠0

Where:

𝜇1 represents the population mean exam score of the first group.

𝜇2​ represents the population mean exam score of the second group.

**7. One-sample t-test: - A manufacturer claims that the mean weight of their cereal boxes is 500 grams. A sample of 30 cereal boxes has a mean weight of 490 grams and a standard deviation of 20 grams. Conduct a one-sample t-test to determine if there is evidence to support the manufacturer's claim at a significance level of 0.05.**

* Population mean (𝜇) = 500 grams
* Sample size (𝑛) = 30
* Sample mean (𝑥ˉ) = 490 grams
* Sample standard deviation (𝜎) = 20 grams
* Significance level (𝛼) = 0.05

Null Hypothesis (𝐻0​): The population mean weight of the cereal boxes is equal to 500 grams. 𝐻0: 𝜇=500

Alternative Hypothesis (𝐻1*H*1​): The population mean weight of the cereal boxes is not equal to 500 grams. 𝐻1: 𝜇≠500

Calculate the t scores:

t = −2.7385

significance level of 𝛼=0.05with 𝑑𝑓=𝑛−1=30−1=29*.*

Since this is a two-tailed test, we need to consider the critical values for both tails. With a significance level of 𝛼=0.05*,* the critical t-values for 𝑑𝑓=29 are approximately ±2.045.

∣𝑡∣=2.7385 > 2.045, we reject the null hypothesis.

Therefore, there is evidence to suggest that the mean weight of the cereal boxes is different from the manufacturer's claim of 500 grams at the 0.05 significance level.

**9. Process Control Example: - A call center manager implements a new training program aimed at reducing call waiting times. The average waiting time before the training program was 4.5 minutes, and after the program, it is measured to be 4.0 minutes with a standard deviation of 0.8 minutes. Conduct a hypothesis test to determine if there is evidence that the training program has reduced waiting times, using a significance level of 0.05.**

Null Hypothesis (H0): The new training program has no effect on reducing call waiting times. In mathematical terms: μ\_after = μ\_before

Alternative Hypothesis (H1): The new training program has reduced call waiting times. In mathematical terms: μ\_after < μ\_before

Where:

μ\_after represents the population mean waiting time after the training program.

μ\_before represents the population mean waiting time before the training program.

For n= 10, z score is −1.976

The critical z-value for a one-tailed test with 𝛼=0.05 is approximately -1.645.

Since the calculated z-score (-1.976) is less than the critical z-value (-1.645), we reject the null hypothesis in favor of the alternative hypothesis.

Therefore, there is evidence to suggest that the training program has reduced waiting times at a significance level of 0.05.

**10. Interpreting Results: - After conducting a hypothesis test, the calculated p-value is 0.02. What can you conclude about the null hypothesis based on this result, assuming a significance level of 0.05?**

The calculated p-value is less than the significance level (*α*), which in this case is 0.05, it indicates that there is sufficient evidence to reject the null hypothesis.

The calculated p-value is 0.02, which is less than 0.05. Therefore, we reject the null hypothesis at the 0.05 significance level.

So, we conclude that the training program has statistically significantly reduced waiting times.

Question no 8: Having doubts regarding the steps that needs to be taken