Z-test

A one-sample z-test is a statistical test used to determine if the mean of your sample data is statistically different from a **predetermined value**, assuming your data follows a normal distribution and you have a large sample size (or know the population variance).

Here's a breakdown of the one-sample z-test:

Hypotheses:

- **Null Hypothesis (H_o):** The mean (μ) of your sample is equal to a predetermined value (μ_o).
- **Alternative Hypothesis (H_1):** The mean (μ) of your sample is not equal to the predetermined value (μ_o). (This can be one-tailed or two-tailed depending on your specific question)

Steps involved:

1. **Calculate the z-statistic:** We use the following formula to calculate the z test statistic:

$$z = (x - \mu 0)/(\sigma/\sqrt{n})$$

where:

- **x:** sample mean
- **μ0:** hypothesized population mean
- **σ:** population standard deviation
- **n:** sample size

2. **Determine the p-value:** The p-value represents the probability of observing your sample mean (or a more extreme value) assuming the null hypothesis (H_o) is true. You can find the p-value using a standard normal distribution table or statistical software.

3. **Make a decision based on the p-value:**
    - **Reject H_o (if p-value < significance level):** This suggests there's evidence against the null hypothesis. The sample mean is statistically different from the predetermined value at your chosen significance level (usually 0.05).
    - **Fail to Reject H_o (if p-value > significance level):** There's not enough evidence to reject the null hypothesis. This doesn't necessarily mean the sample mean is equal to the predetermined value, but you don't have strong enough evidence to say otherwise with your current data.

Z Test for Proportions

Steps involved:

1. **Calculate the sample proportion (p):** This is the proportion of successes observed in your sample (number of successes divided by total sample size).
2. **Calculate the standard error (SE):** This reflects the variability you might expect to see in the sample proportion (p) due to random sampling. It's calculated using the formula:

    $$SE = sqrt(p_0 * (1 - p_0)/n)$$

    where:

    - p_o: Hypothesized population proportion
    - n: Sample size
3. **Calculate the z-statistic:** This statistic reflects how many standard errors your sample proportion (p) falls away from the hypothesized proportion (p_o). The formula is:

    $$z = (p - p_0)/SE$$

4. **Determine the p-value:** The p-value represents the probability of observing your sample proportion (or a more extreme value) assuming the null hypothesis (H_o) is true. You can find the p-value using a standard normal distribution table or statistical software.
5. **Make a decision based on the p-value:**
    - **Reject H_o (if p-value < significance level):** This suggests there's evidence against the null hypothesis. The sample proportion is statistically different from the predetermined value at your chosen significance level (usually 0.05).
    - **Fail to Reject H_o (if p-value > significance level):** There's not enough evidence to reject the null hypothesis. This doesn't necessarily mean the sample proportion is equal to the predetermined value, but you don't have strong enough evidence to say otherwise with your current data.

Z-distribution