Z-Test

A two-sample z-test is a statistical test used to compare the means of two **independent groups** when the population standard deviations are known (or assumed to be known). It's similar to the two-sample t-test but has slightly different assumptions and applications.

When to use a two-sample z-test:

- You have **independent data** from two separate groups.
- The population standard deviations (σ_1 and σ_2) for both groups are known or assumed to be known.
- The data in each group is **approximately normally distributed**.

Steps involved in a two-sample z-test:

1. **Formulate the hypothesis:**
    - **Null hypothesis (H0):** There's no significant difference between the means of the two populations ($\mu_1 = \mu_2$).
    - **Alternative hypothesis (HA):** There's a significant difference ($\mu_1 \neq \mu_2$). You can also specify a one-tailed hypothesis (HA: $\mu_1 > \mu_2$ or $\mu_1 < \mu_2$) if you expect the difference to be in a specific direction.

2. **Collect data:** You need independent samples from each group with an appropriate sample size.

3. **Calculate the test statistic (z-score):** This involves the sample means ($\bar{x}_1$ and $\bar{x}_2$), sample sizes (n_1 and n_2), and the known population standard deviations (σ_1 and σ_2). The formula looks like this:

$$z = (\bar{x}_1 - \bar{x}_2)/sqrt((\sigma_1^2/n_1) + (\sigma_2^2/n_2))$$

4. **Determine the p-value:** The p-value represents the probability of observing a test statistic as extreme or more extreme than the calculated value, assuming the null hypothesis is true. You can use a z-table or statistical software to find the p-value based on the calculated z-score.

5. **Interpret the results:**
    - Choose a significance level (alpha, typically 0.05).
    - If the p-value is less than alpha, you reject the null hypothesis and conclude there's a significant difference between the means of the two groups at the chosen significance level.
    - If the p-value is greater than alpha, you fail to reject the null hypothesis. There's not enough evidence to say the means are different at the chosen significance level.