Two-Sample t-Test

Answers a yes/no question about the means μ_A and μ_B of two different populations. Lets you decide if there is statistically significant evidence that μ_A and μ_B are different.

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

$$H_0\colon\ \mu_A = \mu_B$$
$$H_A\colon\ \mu_A \neq \mu_B$$

- $\bar{x}_A, \bar{x}_B$ are the sample means
- s_A, s_B are the sample standard deviations
- n_A, n_B are the sample sizes

Steps

These are exactly the same as the steps for a **one sample t-test**, except that the degrees of freedom (df or ν) will be the smaller sample size minus one, i.e., either $n_A - 1$ or $n_B - 1$.

Two-Sample t-Confidence Interval

Estimates the difference between two population means μ_A and μ_B. We can be confident that the true gap $\mu_A - \mu_B$ is between the upper and lower bound from the formula.

$$\bar{x}_A - \bar{x}_B \pm t^* \sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}}$$

- $\bar{x}_A, \bar{x}_B$ are the sample means
- n_A, n_B are the sample sizes
- s_A, s_B are the sample standard deviations
- t^* is the critical t-value

How to Get the Critical t-Value

Use the **t-Distribution Table** exactly the same as for a **one sample t-confidence interval**, except use the smaller sample size to find the degrees of freedom. So df $= n_A - 1$ or $n_B - 1$, whichever is smaller.

Assumptions

The assumptions for both two sample t-tests and t-confidence intervals are almost exactly the same as the one sample t-distribution methods.

1. **Randomness** Both samples are simple random samples from large populations (no sample bias).
2. **Normality** Both populations have a normal distribution.

The normality assumption gets less important as the sample sizes get bigger. Two sample t-distribution methods are even more robust than one sample methods. You can add the two sample sizes together to decide if you have large ($n_A + n_B \geq 30$), or small ($n_A + n_B < 30$) samples.