9.3: Hypotheses with Two Samples

The process of testing hypotheses using an independent samples t-test is the same as it was when comparing a sample to a population with the one-sample t-test. It all starts with stating our hypotheses and laying out the criteria we will use to test them.

Research Hypotheses

Our research hypotheses are still predicting that one group will have a bigger mean than the other group (direction) or that the two means will be different (non-directional). The only difference in the research hypothesis between an independent samples t-test and a one-sample t-test is that instead of comparing a sample mean ($\bar{X}$) to a population mean (μ), we are now comparing two sample means (and no population mean). Because we have two sample means (two $\bar{X}$), we have to label them somehow. We do this with a subscript. Often this is a little number 1 or number 2, but when you know who the sample is, it's often helpful to use letters related to the group name as the subscript.

$$RH: \bar{X}_1 > \bar{X}_2$$
$$RH: \bar{X}_1 < \bar{X}_2$$
$$RH: \bar{X}_1 \neq \bar{X}_2$$

Null Hypotheses

Our null hypothesis for an independent samples t-test is the same as always: there is no difference between the means. The means of the two groups are the same under the null hypothesis, no matter how those groups were formed. In symbols, this looks like:

$$NH: \bar{X}_1 = \bar{X}_2$$

$$NH: \text{ There is no difference between the means of the two groups}$$

Your Research Hypothesis and the Null Hypothesis Work Together

Again, we are now dealing with two means instead of just one, so it will be very important to keep track of which mean goes with which sample data. We use subscripts to differentiate between the populations, so make sure to keep track of which is which. If it is helpful, you can also use more descriptive subscripts. To use an experimental medication example:

Words and Symbols:

- Research Hypothesis: The mean of the treatment group will be higher than the mean of the control group.
  - Symbols: $\bar{X}_{\text{treatment}} > \bar{X}_{\text{control}}$
- Null Hypothesis: There is no difference between the means of the treatment and control groups
  - Symbols: $\bar{X}_{\text{treatment}} = \bar{X}_{\text{control}}$

Next Step: Decision Criteria

Once we have our hypotheses laid out, we can set our criteria to test them using the same three pieces of information as before: significance level (α). For an independent samples t-test, the Degrees of Freedom are:

$$df = N_1 + N_2 - 2$$

This looks different than before, but it is just adding the individual degrees of freedom from each group ($N-1$) together ($df = (N_1 - 1) + (N_2 - 1)$). Notice that the sample sizes, N, also get subscripts so we can tell them apart.

For an independent samples t-test, it is often the case that our two groups will have slightly different sample sizes, either due to chance or some characteristic of the groups themselves. Generally, this is not as issue, so long as one group is not massively larger than the other group. What is of greater concern is keeping track of which is which using the subscripts.

- Dr. MO (Taft College)