T-Test Summary

* T-tests are used to determine whether two means are significantly different. Specifically, t-tests indicate whether the difference between two means is likely due to chance, or whether the difference is likely due to some other factor. The factor can be something such as an experimental treatment, or it can test whether the subjects came from the same population. For example, if we compared total shoulder range of motion in a group of subjects with brachial plexus birth palsy to a group of typically developed subjects, we’d expect the t-test to produce a significant result, which would indicate that the data came from two distinct populations.
* There are two forms of the t-test: the t-test for independent groups, and the dependent t-test, or t-test for repeated measures.
* A t-test for independent groups looks somewhat similar to a Z-score. A Z-score has the following equation:

$$Z=\frac{X-\overbar{X}}{S}$$

* while the equation for t is:

$t=\frac{\overbar{X}\_{1}-\overbar{X}\_{2}}{SE}$ where $SE=\sqrt{\left(\frac{S\_{1}^{2}}{N\_{1}}+\frac{S\_{2}^{2}}{N\_{2}}\right)}$

$$where SE is the standard error of the sampling distribution of differences$$

* The final equation then becomes:

$$t=\frac{\overbar{X}\_{1}-\overbar{X}\_{2}}{\sqrt{\left(\frac{S\_{1}^{2}}{N\_{1}}+\frac{S\_{2}^{2}}{N\_{2}}\right)}}$$

* If the group sizes are different, the variances are weighted using the following:

$S\_{p}^{2}=\frac{\left(n\_{1}-1\right)S\_{1}^{2}+\left(n\_{2}-1\right)S\_{2}^{2}}{n\_{1}+n\_{2}-2}$,

and

$$t=\frac{\overbar{X}\_{1}-\overbar{X}\_{2}}{\sqrt{\left(\frac{S\_{p}^{2}}{n\_{1}}+\frac{S\_{p}^{2}}{n\_{2}}\right)}}$$

* The degrees of freedom associated with the independent groups t-test is n1+n2-2
* SPSS reports two forms of the t-test: one with equal variances assumed, and one with equal variances NOT assumed.
* Equality of variance is determined via Levene’s test. If this test is significant, then variances between groups are not equal.
* For the dependent t-test, the equation becomes:

$t=\frac{\overbar{D}}{{S\_{D}}/{\sqrt{N}}}$,

where $\overbar{D}$ = the mean difference between samples, and ${S\_{D}}/{\sqrt{N}}$ is the standard error of the differences.

The degrees of freedom associated with the dependent sample t-test is n-1, where n=number of pairs of data.

* Effect size for the t-test is usually calculated using r, and the equation for the effect size is:

$$r=\sqrt{\frac{t^{2}}{t^{2}+df}}$$

* For r, a value of 0.1 represents a small effect, 0.3 a medium effect, and 0.5 a large effect.