Project: Analyzing the Stroop Effect

1. The independent variable is the type of condition under which the test is taken: with congruent words or incongruent words. The dependent variable is the time it takes to name ink colors in lists of equal length.

2. The Null Hypothesis is that the incongruent word condition will make no difference to the time it takes to complete the test. If we are unable to reject the null, then the time taken will be equal under the two different conditions. The alternative hypothesis is that the incongruent word condition will *increase* the time it takes to complete the test. These hypotheses are represented below where μ represents extending the sample size to the population at large, $_C$ the congruent work condition, and $_I$ the incongruent word condition:

   $H_0 : \mu_C = \mu_I$ or $\mu_C - \mu_I = 0$
   $H_A: \mu_C < \mu_I$ or $\mu_C - \mu_I < 0$

   We could write our alternative hypothesis simply that the time will not be equal for the two tests; but since the incongruent words are designed to mildly confuse or disorient the test-taker, it is more accurate to expect that time will increase under this condition. *Because we are specifying a direction in which the subject will be influenced, we will use a one-tailed test to check our hypothesis.*

   We will measure time to complete the tests by comparing sample means for the two conditions. This is a *within-subject test* (*an example of a dependent test*), so we will take the difference in time it took for each person to complete the test under the two conditions. Next we will calculate the standard error for these differences. Using this standard error, we can calculate the t score for the difference between the sample means.

   Since we are comparing two sample means, and do not have any statistics on the population as a whole (specifically the population standard deviation or σ), we are not able to use z scores to test our hypothesis. We instead must rely on a t table.

   From this t score we can analyze:
   (i) The likelihood any difference in mean was due to chance (using a t table)
   (ii) The correlation measure of r squared – how much was an increase in time due to a change in condition?

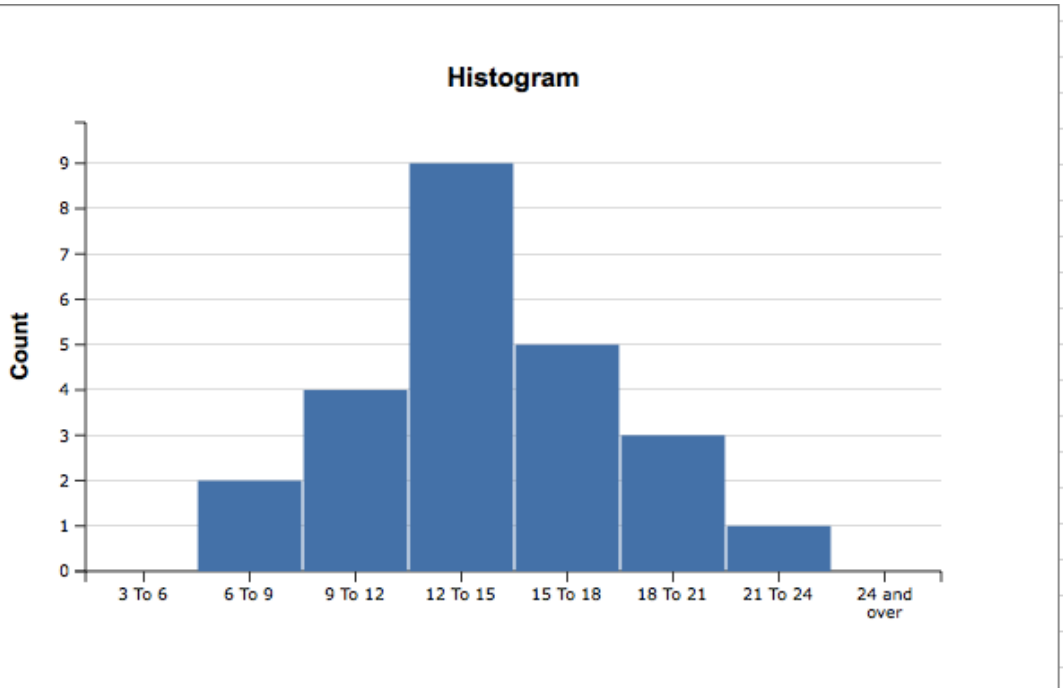
   One assumption we are making with this test is that *carry-over effect* will not significantly impact our results. This is a weakness of all dependent tests. In this case, we are assuming that taking the test under congruent conditions

will not familiarize participants with the structure of the test, that their incongruent scores are better than they would have been otherwise. We are also assuming that the influence of outliers on the data will not distort the mean and thereby the standard deviation and sample error of the data.

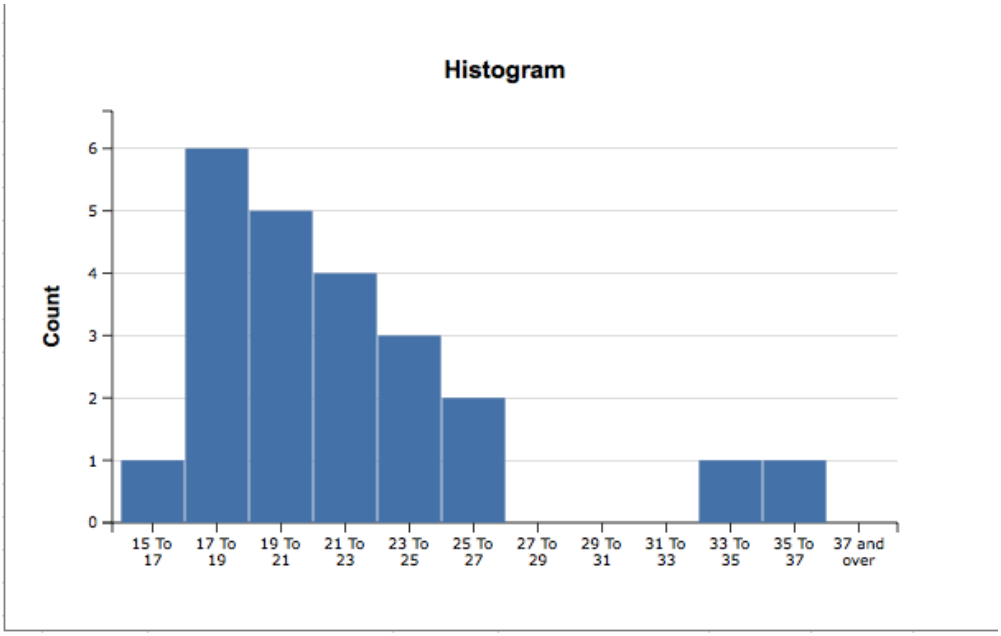
3. Statistics for congruous, incongruous, and the difference between these conditions are below. For each sample, S represents standard deviation, S.E represents sample error for n = 24

	Congruent	Incongruent	Difference
Average	14.05	22.02	7.96
S	3.56	4.80	4.86
SE	0.73	0.98	0.99

4. The first histogram below depicts the distribution of the time in seconds taken to complete the color identification under **congruent** conditions. The data is very evenly distributed. The middle bin 12 – 15 represents 37.5% of the data. If we extend this area to one bin on either side, 75% of the data falls within the range of 9 – 18. Because of the normal distribution of the data set, we can expect the mean to be closely equal to the mean. Most of the data is within one standard deviation from the mean.



The histogram below shows the same dependent variable under **incongruent** conditions. The data is positively skewed with a few outliers to the right of the histogram. Because of this the medium will be less than the mean.



5. Our sample data has 23 degrees of freedom. Our alternative hypothesis states that the average time will *increase* under incongruous conditions. For this reason, we will use a single tailed test when choosing an alpha level. For an alpha level of .05, our t-critical level is +1.714. Our t score must be above this value for us to reject the null with 95% certainty.

   The average difference in time between the two conditions is 7.96. We can calculate this value either by subtracting the two sample means, or by finding the average difference in time between the conditions for each test-taker. Our sample error is the standard deviation (4.89) of the difference (using n - 1) divided by the square root of n (5). This value for the sample error is given above as .99. We can find the t score of the differences between conditions by dividing the difference in means (7.96) by the sample error (.99). When we do this, we get a t-statistic/score of 8.02.

   This t score or 8.02 is very comfortably above the t critical value of 1.714. In fact, the t score is so high that we can reject the null with almost 100% certainty. We can conclude that performing the test under incongruous condition will increase the time taken by an average of 7.96 seconds. This result certainly matched my expectations. When I took the test, I found it very difficult to name the color of the word without simultaneously reading what the word was. Under incongruous conditions this caused there to be

two answers or colors I was thinking about. Each time it took me a little extra time to decide with of these colors was the color of the word and which was the color I had read.