# The "Stroop Effect" Analysis

Project 1: Data Analyst Nanodegree

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## 1 What is our independent variable? What is our dependent variable?

Our independent variable is the congruence or incongruence of the colors with the words. Our dependent variable is the time taken to name the list of colors.

## 2 What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices

The null hypothesis will be that the mean time required to name the congruent colors will be equal or higher than the mean time required to name the incongruent colors.

The alternative hypothesis is that the mean time required to name the congruent colors will be lower than the mean time required to name the incongruent ones.

We need to check if the two samples come from different populations or if they are only different by chance, as we don't know the population parameters, we will use a t-test. We only care if the mean time for the congruent case is smaller than the mean time for the incongruent one, so it will be a one-tail t-test.

As we are using the same subjects on two different situations, our samples are dependent, so we are going to use a *one-tail paired t-test*.

To summarize:

$$\begin{cases} H_0 : \mu_c >= \mu_i \\ H_a : \mu_c < \mu_i \end{cases} \tag{1}$$

## 3 Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability

Once we calculate the differences, we get that $\mu_{diff} = -7.97$ and $s_{diff} = 4.86$, so it looks like our values are very spread out around -7.97 seconds.

## 4 Provide one or two visualizations that show the distribution of the sample data. Write one or two sentences noting what you observe about the plot or plots

From the histogram (Figure 1) we see it looks like a bimodal distribution, with one mode range around -3 seconds and the other one around -10 seconds. We also realize that there is no positive score on any row, so that confirms we made a right choice using one tail test.

If we look now at our *t* distribution (Figure 2), we realize that our confidence interval for 95% is going to be around $[-10, -6]$ seconds, so probably we are going to reject the null.

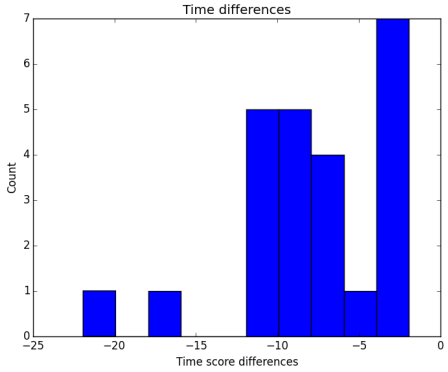


Figure 1: Histogram of differences

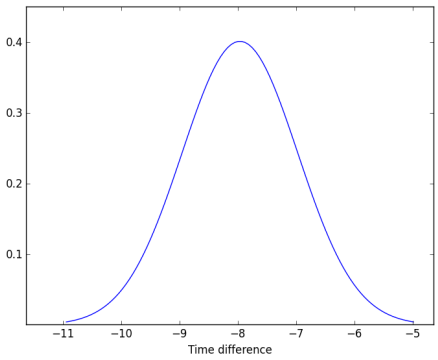


Figure 2: t distribution

## 5 Now, perform the statistical test and report your results. What is your confidence level and your critical statistic value? Do you reject the null hypothesis or fail to reject it? Come to a conclusion in terms of the experiment task. Did the results match up with your expectations?

We are preforming a two samples one side t-test, our results are:

$$t(23) = -8.02, \quad p << 0.01, \quad onetail$$

Our critical value at $\alpha = 0.01$ is $t = -2.5$ so we can reject the null with confidence, our calculated $t$ is well beyond that point.

It is proven that the Stroop Effect is real, and people get much better scores when they use congruent colors, which is the result we were expecting.

## 6 What do you think is responsible for the effects observed? Can you think of an alternative or similar task that would result in a similar effect?

The main theory [1] to explain this is that the brain is more used to reading text that to recognize colors, so it gets the meaning of the word faster than its color.

Probably an experiment with the words "up, down, left, right" and their position on the page will yield us similar results.

## References

[1] Wikipedia, Stroop Effect, `https://en.wikipedia.org/wiki/Stroop_effect`