

# Analyzing the Stroop Effect

Perform the analysis in the space below. Remember to follow the instructions and review the project rubric before submitting. Once you've completed the analysis and write up, download this file as a PDF or HTML file and submit in the next section.

(1) What is the independent variable? What is the dependent variable?

The dependent variable (DV) is a True or False value regarding if the words shown were congruent (the word shown is the name of the color of the word shown) or incongruent (the word shown is the name of a different color than the color of the word shown).

The independent variable (IV) is the time it took for every participant on the test to say the colors of the words readed.

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

Null Hypothesis (H0): There is no meaningful statistical difference in the time it takes for any test-taker to name the color of the words shown, between words in congruent and incongruent conditions.

$$H0: \mu_{\text{congruent}} = \mu_{\text{incongruent}}$$

Alternative Hypothesis (H1): There is a meaningful statistical difference in the time it takes for any test-taker to name the color of the words shown, between words in congruent and incongruent conditions.

$$H1: \mu_{\text{congruent}} \neq \mu_{\text{incongruent}}$$

Considering both of our hypothesis, our main goal is to infer if two means taken from the same population after certain condition changes differ or not from each other.

Since we have two samples, our sample "n" is minor than 30, and we don't know the population's standard deviation, the adequate statistical test to perform in order to validate one hypothesis is a Paired t-test, which according to <http://support.minitab.com> [1], it "tests whether the mean of the differences between dependent or paired observations is equal to a target value".

To perform a t-test there are two main conditions to be met:

Condition 1: The data were collected in a random way, each observation must be independent of the others.

Condition 2: The sampling distribution must be normal or approximately normal.

Condition 1 is met by the way the data was collected. We will later in this document review if the condition 2 is met by plotting the data distribution and comparing it to a normal distribution.

The resulting p-value related to the paired t-test is a value between 0 and 1 that means the probability of not rejecting  $H_0$ .

(3) Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability. The name of the data file is 'stroopdata.csv'.

	Congruent	Incongruent
<b>count</b>	24.000000	24.000000
<b>mean</b>	14.051125	22.015917
<b>std</b>	3.559358	4.797057
<b>min</b>	8.630000	15.687000
<b>25%</b>	11.895250	18.716750
<b>50%</b>	14.356500	21.017500
<b>75%</b>	16.200750	24.051500
<b>max</b>	22.328000	35.255000

Table 1. Descriptive statistics for Congruent words test and Incongruent words test.

The table above, made using the function `pd.describe()`, "generates descriptive statistics that summarize the central tendency, dispersion and shape of a dataset's distribution, excluding NaN values" [2]

(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.

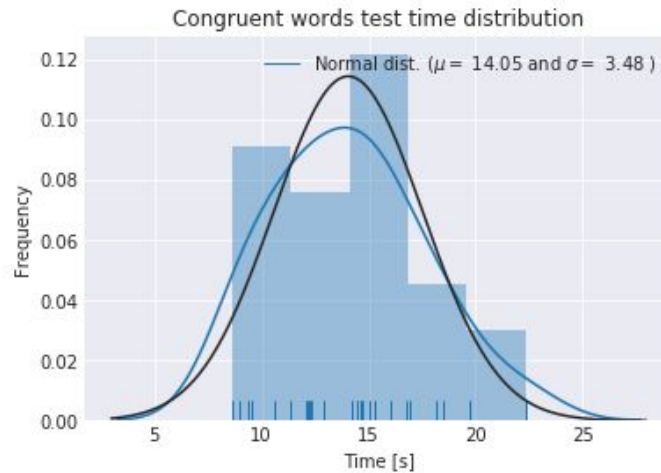


Figure 1. Congruent words test time distribution (blue)  
Fitted normal distribution for congruent words test time (black).

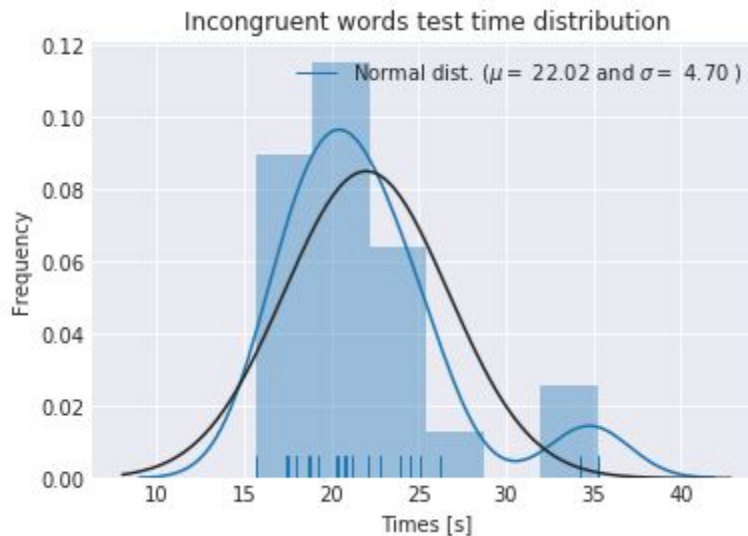


Figure 2. Incongruent words test time distribution (blue)  
Fitted normal distribution for incongruent words test time (black).

As we can see in both plots, the data is approximately normally distributed, and therefore the t-test Condition 2 is met.

(5) Now, perform the statistical test and report the results. What is the 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?

The t-value for a paired t-test on the given data is equal to 8.021.

The p-value for a paired t-test on the given data is equal to  $4.103e-08$ .

What the p-value means is that only  $4.103e-06$  % of the times that we perform the same Stroop effect test the null hypothesis ( $H_0$ ) would be true.

Said that, we can safely say that there is indeed a difference in the time it takes to complete the test with congruent words and to complete the test with incongruent words.

(6) Optional: 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? Some research about the problem will be helpful for thinking about these two questions!

## **References:**

- [1] Paired t-test description. Source: <http://www.minitab.com/es-mx/support/>
- [2] `pd.describe()` function description. Source: <https://pandas.pydata.org/>
- [3] Graph inspired in a Kaggle Kernel. Source: <https://www.kaggle.com/serigne/stacked-regressions-top-4-on-leaderboard>