Statistics: The Science of Decisions Project Instructions

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

Independent variable:

In this case, words are the independent variable because it is the one than the experimenters choose to manipulate. There are congruent words and incongruent ones. Based on this independent variable, they measure the dependent one.

Dependent variable:

The experiments records **the time** participants need to say out loud the colour of the ink. This is the variable that experimenters choose to measure during the experiment.

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

$H_0 : \mu_c = \mu_i$

The **Null Hypothesis** specifies that the difference between the population means are not significantly different. So, the difference is big enough that the sample means difference are not just by change. In terms of independent variable, this null statement says that the mean time needed to read congruent and incongruent words is not significantly different.

$H_A : \mu_c \neq \mu_i$

Alternative Hypothesis says that there is a significant difference between the population means and it can be in negative or positive direction.

The results could show that time difference is greater or smaller, so it has to be a **two-tailed test**. The experiment was conducted in a way that every participant gets both lists of words, so the test will be a **dependent t-test for paired samples**. The decision to take a t-test is because:

- The sample size is 24, below 30.
- We don't know population standard deviation.

Taking in account that our sample is below 30, we cannot even estimate population standard deviation. So, instead of Z-Score we need to do a T-score test.

The type of t-test is a t-test for paired samples because we are measuring and working with the mean difference between dependent or paired observations. This test is used when we want to determine whether the mean of the differences between two paired samples differs from 0, as our null and alternative hypothesis show.

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

Congruent words mean: 14,05 seconds
Incongruent words mean: 22,02 seconds

Congruent words range: 8,63 - 22,328 = 13.70
Incongruent words range: 15,687 - 35,255 = 19.57

Congruent words variance: 12,67
Incongruent words variance: 23,01

The statistics show a smaller mean for congruent words, with smaller range of values and smaller variance. This statistics shows that reading congruent words is faster, but we still don't know if it is significant faster.

Source of information used:
http://onlinestatbook.com/2/summarizing_distributions/variability.html

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.
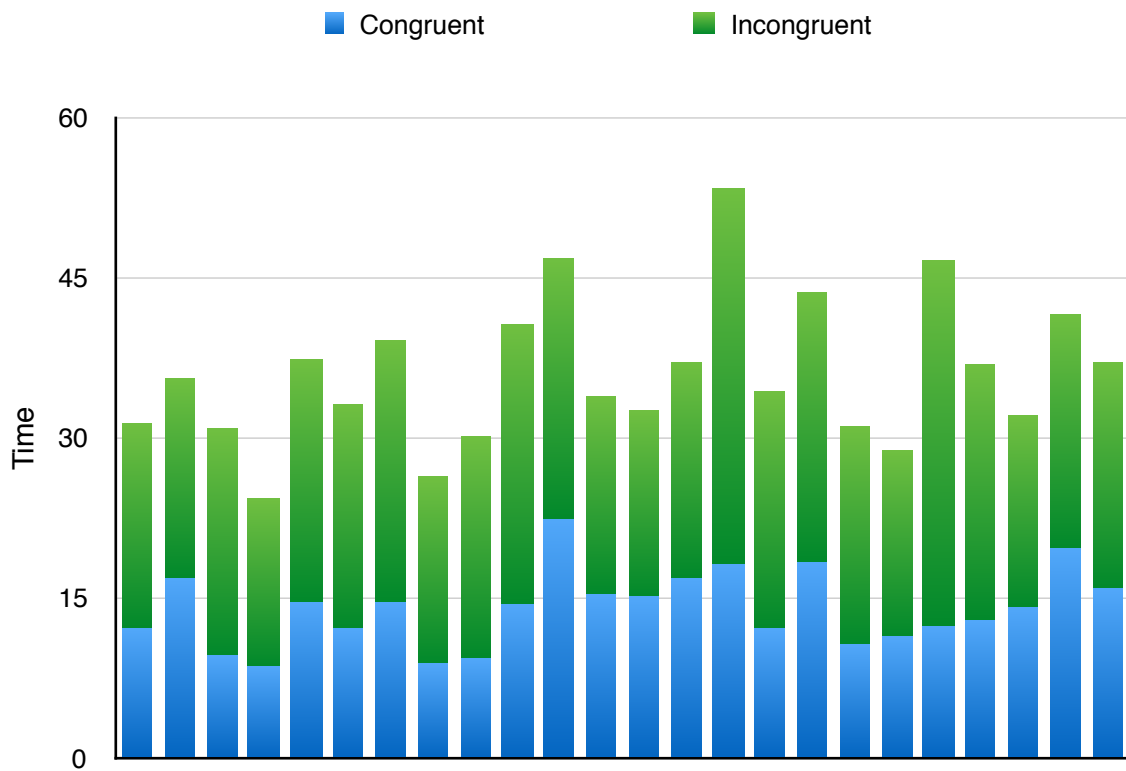
The graph shows a stacked histogram with time results from congruent and incongruent tests. Each column shows the total time needed to do both tests, and the time spent on each test identified by the bar colour. It shows that the time spent in incongruent test is always larger than the congruent one.

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?

α : 0,05 (95%)
SD of differences: 4,86
t statistic: -8,02
t critical: ±2,068

Taking the negative t-critical value, we see that our t statistics is far away from that point into the negative area. That means that **we reject the null**, so the time needed to read incongruent words is significantly different from the time needed to read congruent ones. The conclusion would be that reading incongruent words takes more time.

The result match up with my expectation for two reasons:

- I also did the test and it was much more difficult and slower to read incongruent words.
- Mean differences and distribution graphs also shows a great difference.

Therefore, my expectations were to go get a similar result to the one showed here.

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!

Stroop effect measures the reaction time of a task, in this case read words with colours. There are different theories that could explain the results, but **processing speed** is the more logical explanation in my opinion. The theory explains that our brain is faster reading words than identifying colours. The word we read arrives in first place, and then some time later we have the colour. If they match, you can go to the next one. If not, there is extra time you need to process the arrived information, compare it and produce the correct answer. **Selective attention** also explains that colour recognition requires more attention than reading a word, that will add also some more processing time making our replies slower. I would say that both are related.

A similar test could be done with numbers varying its size. You can show a pair of numbers and ask the subject to read the smaller value. It takes more time with an incongruent trial because physical size has close relationship.

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https://en.wikipedia.org/wiki/Stroop_effect