P1: Test a perceptual phenomenon

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

- The dependent variable is the time spent to say the ink color of each word.

- The independent variable is the color of the ink used to write a word.

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

An appropriate set of hypothesis could be:

H_0: The mean time spent to say the color of the ink in the population would be the same or less in incongruent disposition compared to congruent disposition.

H_1: The mean time spent to say the color of the ink in the population would increase in incongruent disposition compared to congruent disposition.

We write μ_{con} the population mean of time to say the color of the ink in the congruent setup, and μ_{inc}: the population mean of time to say the color of the ink in the incongruent setup. The hypotheses become:

- H_0: $\mu_{con}-\mu_{inc} \leq 0$

- H_1: $\mu_{con} < \mu_{inc}$

We would do a one-tailled, paired dependent sample, mean comparison test, such as a t-test.

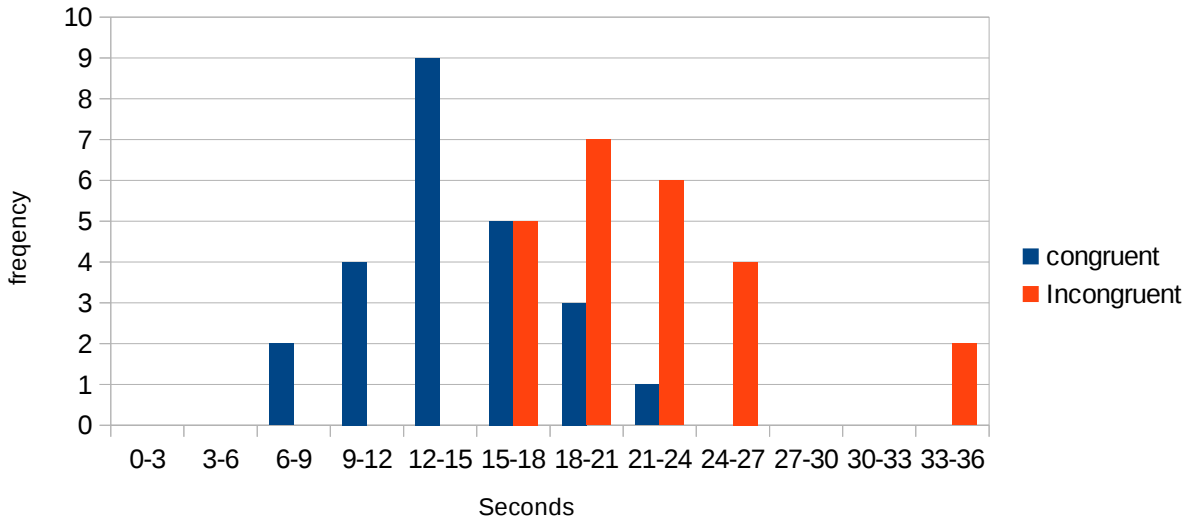
We choose to do a one-tailled test because we expect a specific direction in the difference between the population means of both conditions. The result coming from the same people doing the experiment in different conditions (congruent and incongruent), we use a test for paired dependent sample. We choose a sample mean comparison test like the t-test because we only know results from the experiment but not the population parameters. Because we have less than 30 samples (24 sample) we can't use a z-test. Also from the shape of the samples distributions (see Q4) we can reasonably assume that samples distributions are Gaussian and so make the assumption that the underlying population follow a normal distribution. The t-test allow us to approximate the populations distributions parameters with less than 30 samples for samples coming from normal populations.

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

congruent: mean = 14.05; median = 14.36; standard deviation = 3.56

incongruent: mean = 22.02; median = 21.01; standard deviation = 4.80

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



Histogram 1: Repartition of time spend to say the ink color during a stroop test with a bucket size of 3 seconds.

We observe that the incongruent condition give higher time in the stroop test in these sample. The congruent condition give a more symmetrical distribution (with bucket 12-15 as the center of the distribution) as the incongruent.

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 perform a one-tailed t-test for dependent sample with an alpha level of 0.05% and 23 degree of freedom. The t-critical value is -1.714. The t calculated (congruent-incongruent) is -8.021. Because the t statistic is smaller than the small critical t (-1.714) we reject the null hypothesis for an alpha level of 0.05.

We conclude that the incongruent condition give statistically higher time to say the ink color than the congruent condition. The result are coherent with our expectations, because we tested if the incongruent dispositions gave a higher time to say the ink color.

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!

The processing of the informations seen by the eyes could be responsible for the effect observed. As stated on the wikipedia [1] and in the reference article they use, there is different theory on what is the actual reason of the effect, but the common idea is that it comes from the way the brain processes the different informations it receives.

An alternative task could be to ask the participant to read the word, having the word printed in congruent or incongruent disposition.

Bibliograpy

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

http://www.statisticshowto.com/when-to-use-a-t-score-vs-z-score/

http://support.minitab.com/en-us/minitab/17/topic-library/basic-statistics-and-graphs/hypothesis-tests/tests-of-means/types-of-t-tests/