Statistics: The Science of Decisions Project Instructions

Background Information

In a Stroop task, participants are presented with a list of words, with each word displayed in a color of ink. The participant's task is to say out loud the *color of the ink* in which the word is printed. The task has two conditions: a congruent words condition, and an incongruent words condition. In the*congruent words* condition, the words being displayed are color words whose names match the colors in which they are printed: for example RED, BLUE. In the *incongruent words* condition, the words displayed are color words whose names do not match the colors in which they are printed: for example PURPLE, ORANGE. In each case, we measure the time it takes to name the ink colors in equally-sized lists. Each participant will go through and record a time from each condition.

Questions For Investigation

As a general note, be sure to keep a record of any resources that you use or refer to in the creation of your project. You will need to report your sources as part of the project submission.

- http://pandas.pydata.org/pandas-docs/stable/generated/pandas.melt.html
- http://docs.scipy.org/doc/scipy/reference/generated/scipy.stats.ttest_rel.html#scipy.stats.ttest_rel
- http://docs.scipy.org/doc/scipy/reference/generated/scipy.stats.shapiro.html
- https://en.wikipedia.org/wiki/Shapiro%E2%80%93Wilk_test
- http://statsmodels.sourceforge.net/devel/generated/statsmodels.graphics.gofplots.ProbPlot.html

1. What is our independent variable? What is our dependent variable?
The independent variable is congruence (categorical), the dependent variable is time needed for naming the ink colors (continuous).

2. What is an appropriate hypothesis for this task? What kind of statistical test do you expect to perform? Justify your choices.
From my experience, an appropriate null-hypothesis is that it takes less or equal time to name the **in**congruent colors, so the alternative hypothesis is that it takes more time to name the congruent colors, because I would expect the dissonance to slow down the reading process.

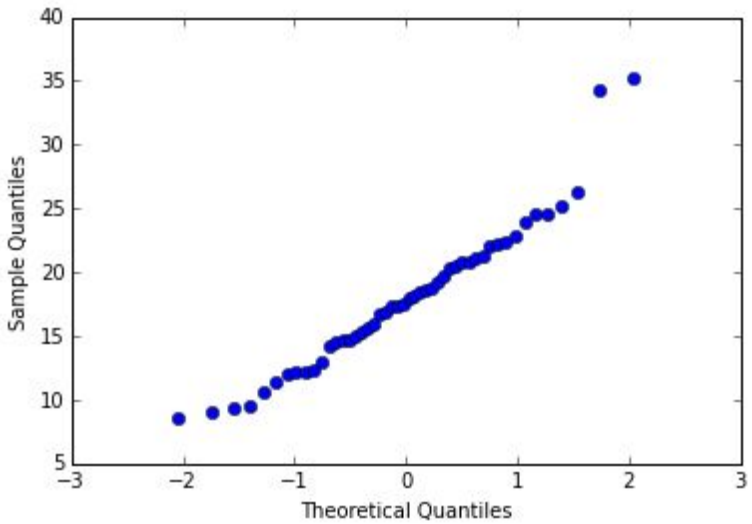
I will perform a one-sided t-test for dependent samples, because the same probands were measured twice. A Shapiro-Wilk test in combination with a Q-Q plot will be suitable for verifying that the data is normally distributed and a t-test can be applied.

Now it's your chance to try out the Stroop task for yourself. Go to this link, which has a Java-based applet for performing the Stroop task. Record the times that you received on the task (you do not need to submit your times to the site.) Now, download this dataset which contains results from a number of participants in the task. Each row of the dataset contains the performance for one participant, with the first number their results on the congruent task and the second number their performance on the incongruent task.

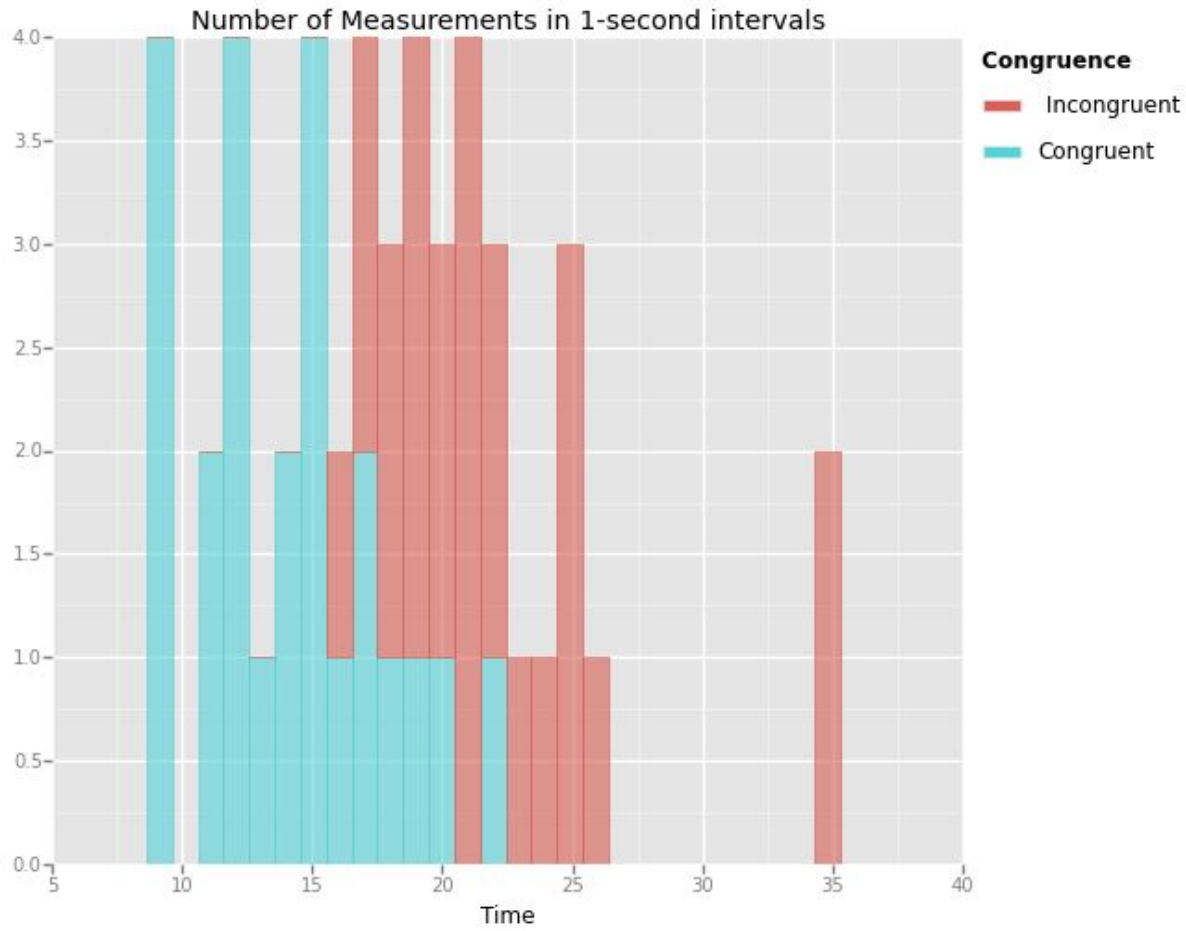
3. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.

	Congruent	Incongruent	
mean	14.051125	22.015917	measure of central tendency
std	3.559358	4.797057	measure of variability

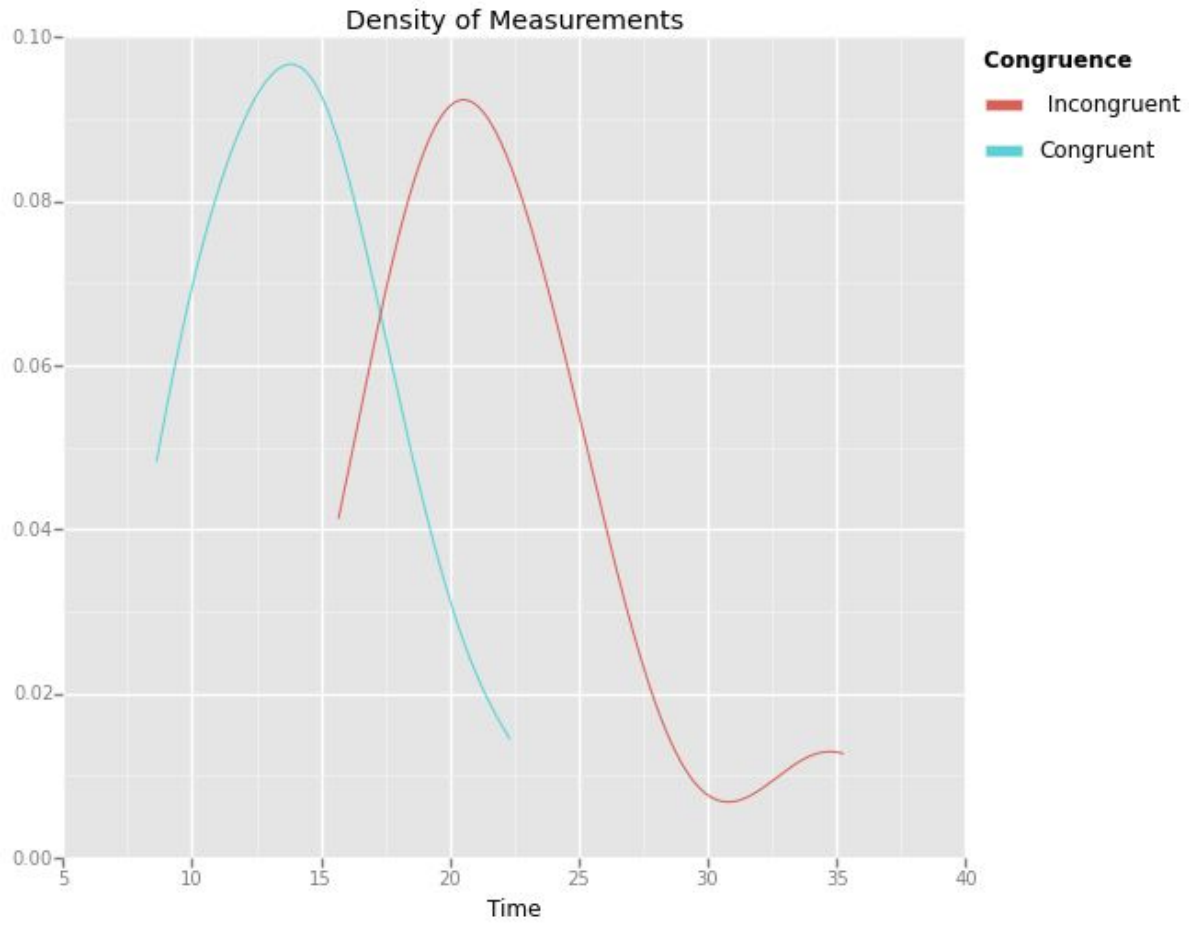
To verify that the data is normally distributed I performed a Shapiro-Wilk test, which resulted in a p value of approximately 0.05. The Q-Q plot shows 2 values outside the normal distribution. I decided to assume that he data is sufficiently normal distributed.



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.



As expected, naming incongruent colors took longer in many cases.



The density plot makes it even clearer that the measurements of naming times are higher when words do not match the ink color.

5. Now, perform the statistical test and report your results. 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?
t value: -8.02070694411, t-critical for $p < 0.01$: -1.25, one-sided p value: 2.05150029286e-08

I reject the null hypothesis, which means that it takes significantly longer to name the ink color if it does not match the word ($p < 0.01$). This is the result I expected.

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!