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.
1. What is our independent variable? What is our dependent variable?
   <u>Independent Variables:</u> The congruent words and incongruent words are the two independent variables.
   <u>Dependent Variable:</u> The time it takes to name the ink colours.

2. What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices.
   <u>Hypothesis:</u>
   H_0: $\mu_c = \mu_i$ (Where μ_c is the mean time for congruent words and μ_i, the mean time for incongruent words)
   H_1: $\mu_c \neq \mu_i$

Verbal null hypothesis:
Above, the null hypothesis (H_0) is that the population mean of the times recorded for the congruent words condition is equal to the population mean of the times recorded for the incongruent words condition.
Verbal alternative hypothesis:
The alternative hypothesis (H_1) is that the two population means are not equal.

I expect to perform a dependent t-test for paired sample within subject designs. This is because the same subject is being tested twice in our sample of data.

A t-test is being conducted, and not a z-test because we do not have the population mean or standard deviation, instead we have a sample of data. This means that we would be using a sample mean and the standard error in our calculations. Further, a t-test is generally used when the sample size is below 30 and in this case, the sample size is 24.

In order to be conservative I will perform a two tailed test for alpha level 0.05.

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

   Please see table below where the mean and median represent measures of central tendency and the stdev and variance represents measures of variability for the sample.

	Congruent	Incongruent	Difference
mean	14.05	22.02	7.96
median	14.36	21.02	7.67
stdev	3.56	4.80	4.86
variance	12.67	23.01	23.67

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.
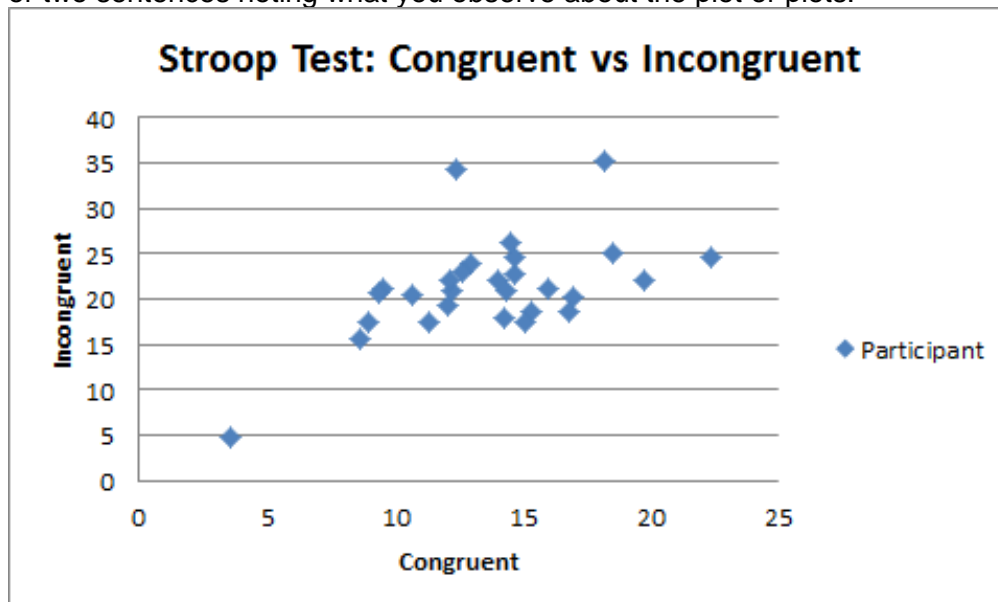

Chart 1: Scatter plot of congruent vs incongruent times for each participant in the Stroop Test
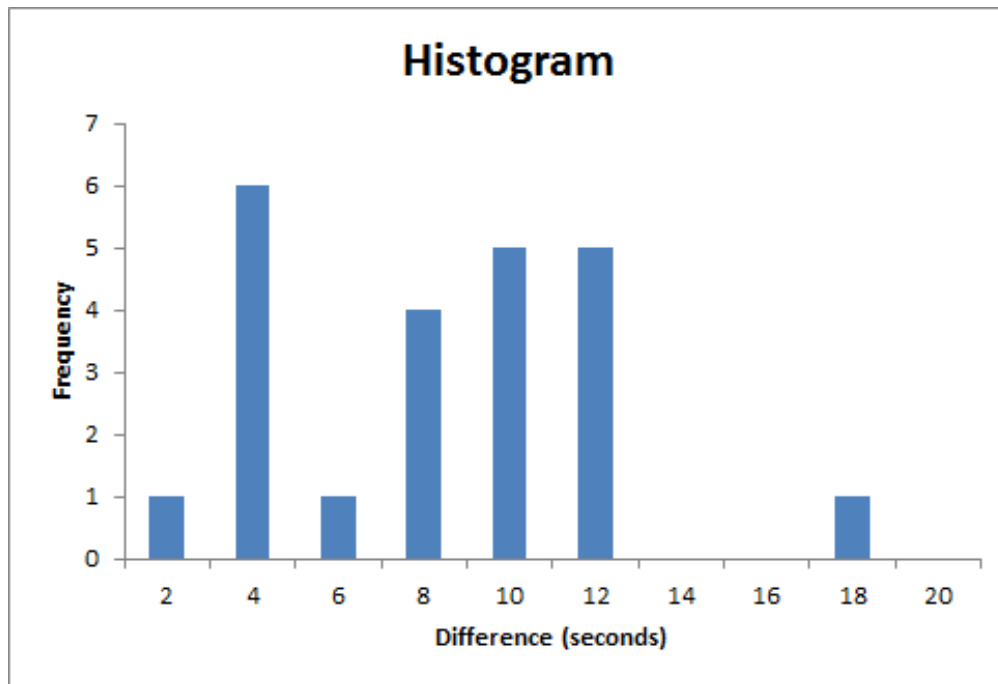
Chart 2: Histogram showing the frequency of the difference between the two observed times in the stroop test, with bin size 2.

Chart 1 suggests that the longer an individual took to go through the congruent words, the longer they took to go through the incongruent words. Most of the data falls in the 10-15 seconds for congruent words and 15-20 seconds for incongruent words area in the scatter plot.

Chart 2 suggests that with the difference in the times taken for each individual participant, the most frequent interval for the difference was between 2 and 4 seconds. However there were also a large number of participants where the difference was between 6 seconds and 14 seconds which is why the mean of the data is closer to 8 seconds.

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?

H_0: $\mu_D = 0$ (Where μ_D is the difference in the two means, μ_c, the mean time for congruent words and μ_i, the mean time for incongruent words)

H_1: $\mu_D \neq 0$

Point estimate, $\mu_D = 7.96$
Standard error = 4.86
n = 24
$t = 7.96/(4.86/\sqrt{24}) = 8.02$

DF = 23
$\alpha = 0.05$
$t_{crit} = 2.069$

Since t > t_{crit} we reject the null hypothesis, at a 95% confidence level, there is a significant difference between the time it takes to go through the congruent list of words compared with the incongruent list of words.

This is as expected, it does seem to be more difficult to go through the list of 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!

   Source: Wikipedia: https://en.wikipedia.org/wiki/Stroop_effect
   There are a number of theories as to why it is more difficult for individuals to go through an incongruent list of words, as per the Stroop test. The most common theory is the theory of automaticity, which suggests that whilst the brain can automatically understand the meaning of words identifying colours is not automatic.

   A similar test could be superimposing shape names onto a drawing of a shape, and naming the shape. For example:

Rectangle	Triangle	Circle
Circle	Rectangle	Triangle