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?

> Independent variable: Whether the condition is congruent or incongruent.
> Dependent variable: the time it takes participant to name the ink colors.

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: Based on the samples, there will be no significant difference of the population mean time to name the ink colors under congruent condition and incongruent condition.

Alternative Hypothesis: Based on the samples, the population mean time it takes to name the ink colors in the incongruent words condition is different from that in the congruent condition.

Statistical Test: Dependent t-test for paired samples.

We do not know the standard deviation of the population, so we will use t-test instead of z-test. In addition, each pair of scores is from the same participant under different conditions, and it is a within subject design. Thus, it should be a dependent test.

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	Difference
Mean	14.05	22.02	-7.96
Median	14.36	21.02	-7.67
Standard Deviation	3.48	4.70	4.76
Variance	12.14	22.05	22.68

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.
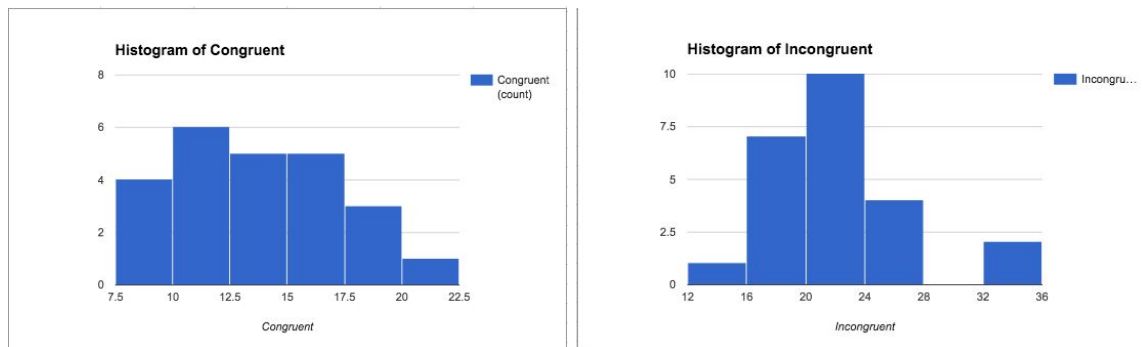
The plots are histograms of time it takes participants to name a color under congruent and incongruent conditions.

The histogram of congruent condition is more like a left skewed normal distribution, whereas the histogram of incongruent condition is a more centered normal distribution. Under congruent condition, the mode of time is 10 to 12.5; under incongruent condition, the mode of time is 20 to 24. The range of time under congruent condition is shorter than that under 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?

T-Test

H_0: μ_{con} = μ_{incon}

H_1: μ_{con} ≠ μ_{incon}

N = 25, α = 0.05
two tail t-test; df = 23

μ_1 = 14.051125
μ_2 = 22.01591667
s = 4.86482691
n = 24

t-critical = ± 2.069

SEM = s / √n = 4.86482691 / √24 = 0.9930286347

t-statistic = (μ_1 - μ_2) / SEM = -8.020706948

For an α level of .05, the t critical value is ±2.069, and t statistics is -8.19, which has passed t critical value. This also means the p value is less than .05. Therefore, we can reject the null, and say that the time it takes to name the color under congruent condition is significantly less than that under incongruent condition.

Effect Size
Cohen's d = Mean Difference / Std Dev of Mean Difference
= (14.05 - 22.02) / 4.86 = -1.64

Margin of error: 2.069 * 0.99 = 2.04831
Confidence Interval:
Lower Bound: -2.04831 -7.97=-10.01831
Higher Bound: 2.04831-7.97=-5.92169

On average, participants use 5.97 to 9.97 less time under congruent condition than incongruent condition.

$r^2 = t^2 / (t^2 + df)$
$\quad = (-8.38)^2 / ((-8.38)^2 + 23)$
$\quad = 0.75$

75% of the time difference is due to the 2 different conditions.

Yes, the results match up with my expectation.

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!