

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 - Color of the words

Dependent variable - Time taken to identify the color

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 - $\mu_c = \mu_i$

I.e Mean time taken to identify the color of the ink in congruent condition (μ_c) is equal to the mean time taken to identify the color of ink in incongruent condition (μ_i).

Alternative hypothesis - $\mu_c \neq \mu_i$

I.e Mean time taken to identify the color of the ink in congruent condition (μ_c) is not equal to the mean time taken to identify the color of ink in incongruent condition (μ_i). There is a difference in the mean time taken to identify the color of the ink between the two conditions.

I would perform a Paired dependent-sample 2 tailed T-test and here's why-

T test because we don't know the population parameters and we are basing our conclusions off a hypothesis testing over sample data.

2 tailed because we are not looking at the direction of the test. We are hoping to prove that there is a difference and not that the mean time taken for one condition is higher or lower than the other.

Dependent paired sample because the same participant is undergoing both tests and we are measuring time for both conditions from each participant and we are controlling for any individual bias differences.

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.

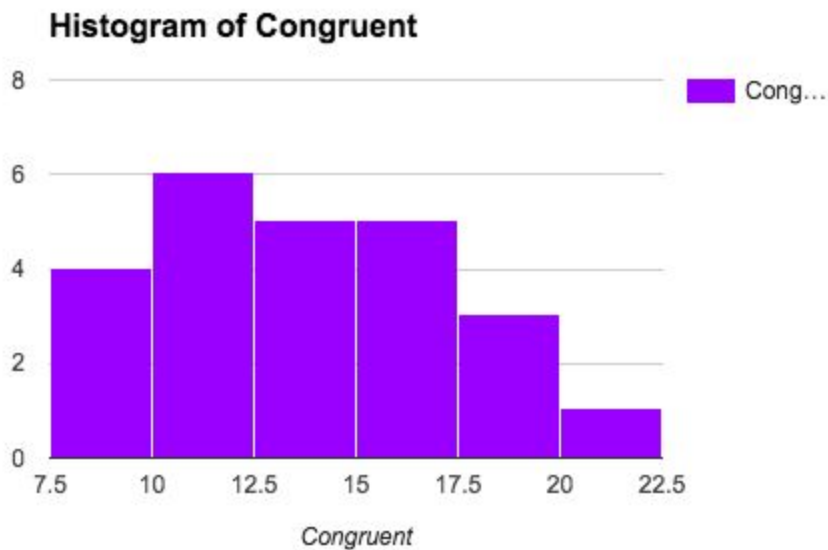
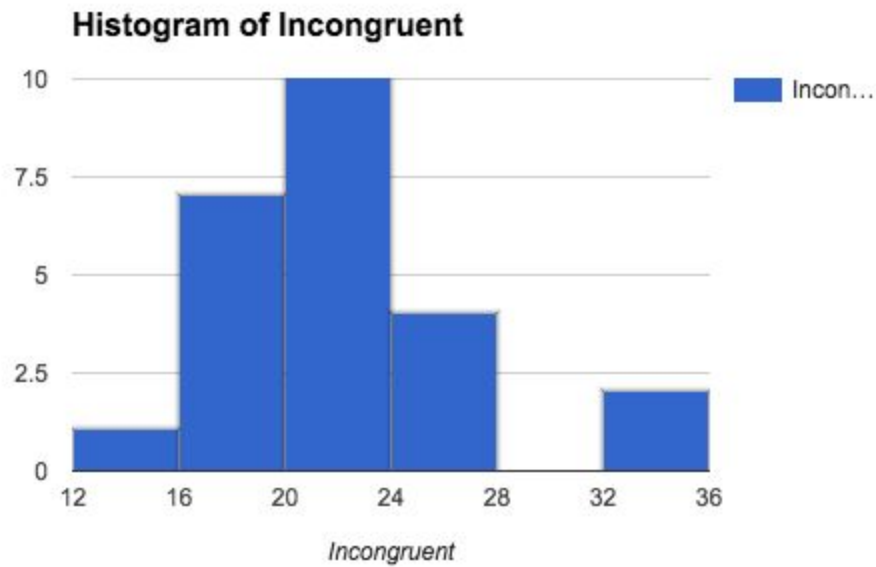
Average mean difference = -7.964791667

Median = -7.6665

Standard deviation of mean difference = 4.86482691

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.

Ans: A histogram of the incongruent data points shows that we have a normal plot with mode interval occurring between 20 and 24.



A histogram for the congruent data doesn't appear to be a perfectly normal plot but we do seek a peek and then the data tapers down on both sides of the peak. We can possibly say that it is right skewed.

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?

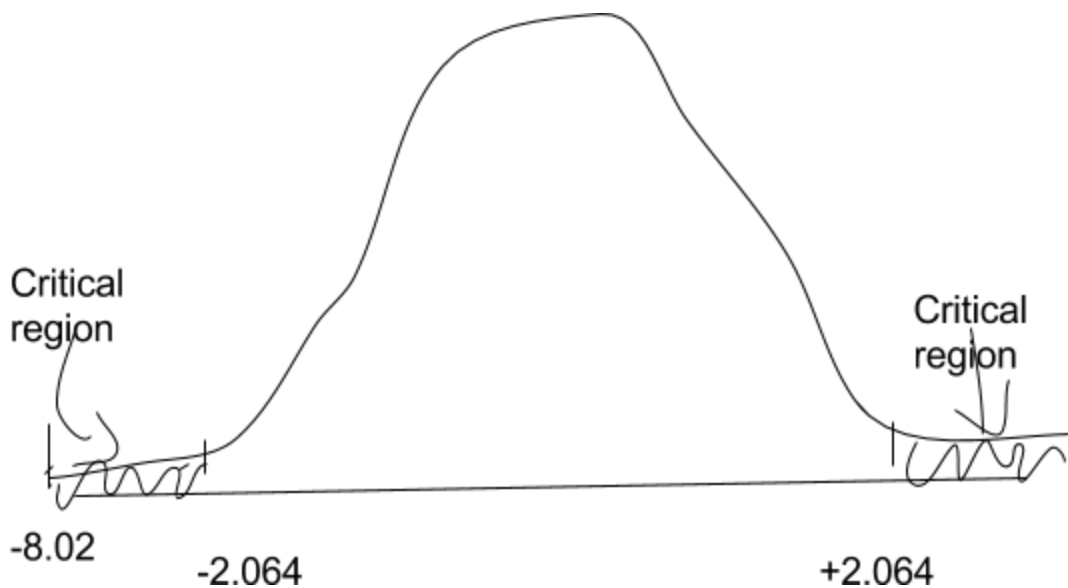
Degrees of freedom = 23 (N-1 with N=24 samples)
Mean diff. = -7.965
Confidence level = 95% with tail probability .025 (2 tailed)
T-critical = 2.064
Standard error of mean = s/\sqrt{n} = 0.993
T-statistic = -8.02

P Value Results

$t = -8.0207069$ DF=23

The two-tailed P value is less than 0.0001

The T-critical value cuts off the critical region on both sides of the t-distribution curve at ± 2.064 .
Critical region is the region to the left of -2.064 and to the right of +2.064.
T-statistic of -8.02 lies in the critical region on the left.



Therefore, it is unlikely that we have this sample by chance. P-value is very less (infact less than 0.0001) which implies that the probability of obtaining this sample by chance is extremely low (much lower than the alpha level of .05) and that means something else is at work here.

Perhaps, this sample represents closely to the behavior of the population. Based on this, I reject the null that there is no significant difference in the mean time taken in both conditions. From the hypothesis test, we can conclude that there is in fact significant difference between the mean time taken to identify the colors correctly between the 2 conditions.

It has matched up with my expectations because I would expect that the brain needs more time to process the name of the color when it doesn't match up to the word. I would expect that to take longer time and therefore a significant difference would exist between the 2 conditions with the time taken for the incongruent condition being significantly higher.

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!