Test a Perceptual Phenomenon

Analysing Data for Stroop Task and analysing questions for investigations

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.

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

Independent Variable : Words - Congruent and incongruent test words
Dependent Variable : Time taken to read the congruent and incongruent words

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

2a. What are appropriate hypothesis for this task?

A Hypothesis test is a statistical test that is used to determine whether there is enough evidence in a sample of data to infer that a certain condition is true for the entire population

A hypothesis test examines two opposing hypotheses about a population: the null hypothesis and the alternative hypothesis.

For our sample of data

Null hypothesis (H_0)

There is **no significant** time difference in the population average response time in viewing the congruent(c) words vs viewing the incongruent(i) words.
That is, the time taken to say the colors is same in both the conditions

Alternative Hypothesis (H1)

There is a significant difference, positive or negative, in the population average response time in viewing the congruent(c) words vs viewing the incongruent(i) words.
That is the the time taken to say the colors in incongruent conditions is different from time taken in congruent condition.

Mathematical Equation for both the hypothesis:

H_0 : $\mu_i - \mu_c = 0$

H_a: $\mu_i - \mu_c \neq 0$

μ_i --> Average time taken to name correct ink color for incongruent words
μ_c --> Average time taken to name correct ink color for congruent words

2b. What kind of statistical test do you expect to perform? Justify your choices.

Statistical test performed is Two - Tailed dependent T - Test because -

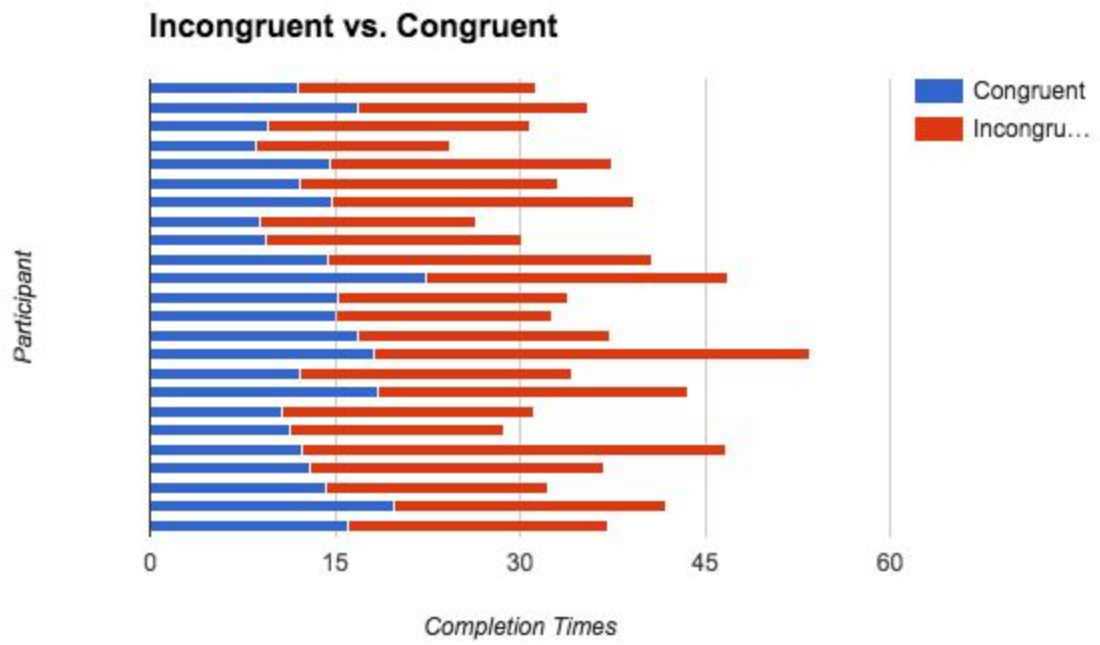
- Since the sample is below 30, we will go with t - score instead of z-score
- Only sample parameters are known, and population parameters are not known and since we do not know the population parameters, so a z-test would not be appropriate here
- I went with dependent test as the same people are playing the congruent and incongruent test and other conditions are same
- These tests are dependent as after doing the test once, participants would have some practice of the test and therefore would have an advantage when giving the second test

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

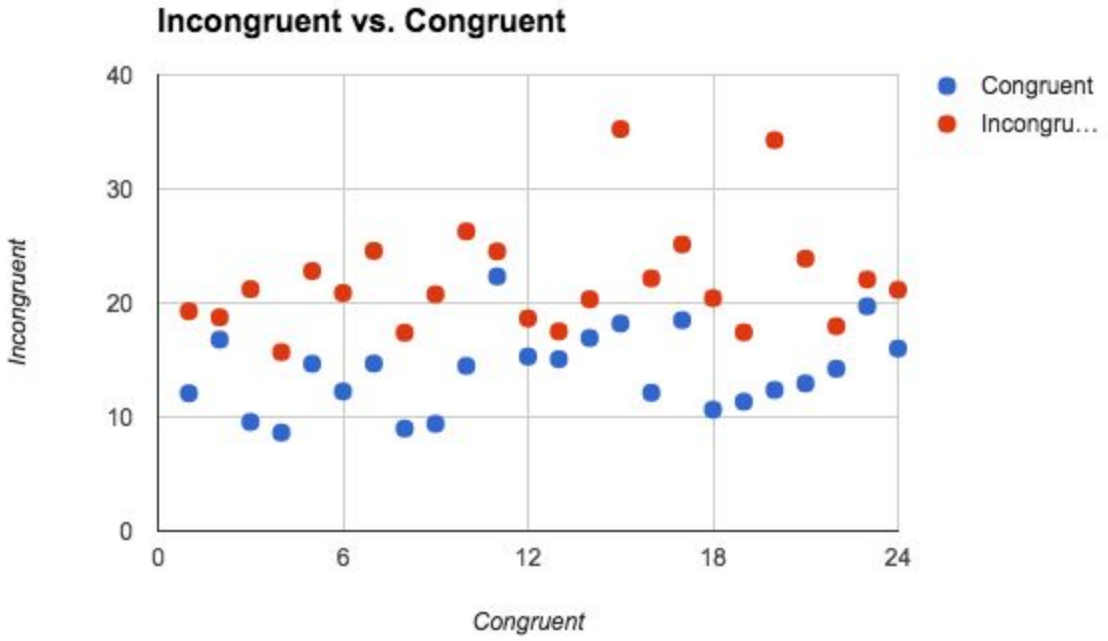
Statistical Parameter	Congruent Word	Incongruent Words
Mean	14.05	22.02
Median	14.36	21.02
Standard Deviation	3.56	4.8

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 following visualization shows each participant's test score when giving congruent or incongruent test and how they varied



The following Scatter Plot shows how the congruent and incongruent times varied with each participant



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?**

Choosing the alpha level to be 0.05, we can calculate the following statistical report

Alpha Level	0.05
Degrees of Freedom (df)	23
T- Critical Value	2.069
Mean Difference	7.97
Standard Deviation of Mean	4.86
Standard Error	0.99
T- Statistic	8.021

P-value << 0.0001, two - tailed test

The T- Statistic is a lot greater than the t-critical and is significant
Based on the above report, we reject the null hypothesis, H_0

The probability for mean time for congruent does not differ from mean time for incongruent is practically zero.

The confidence interval would be (95% CI) → (5.97,10.07)

These results are as expected as when I attempted the test, The difference for me was around 8.3 seconds, which lies in our confidence interval.

References

1.https://en.wikipedia.org/wiki/Stroop_effect
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3. https://www.rit.edu/cla/gssp400/sbackground.html
4. http://www.statisticshowto.com/when-to-use-a-t-score-vs-z-score/

5. http://www.mathsisfun.com/data/standard-deviation.html