

Investigate a Perceptual Phenomenon Called the Stroop Effect

Resources :

1. https://en.wikipedia.org/wiki/Stroop_effect
2. <https://faculty.washington.edu/chudler/java/ready.html>
3. <https://drive.google.com/file/d/0B9Yf01UaIbUgQXpYb2NhZ29yX1U/view> : Data for this analysis

Q & A

Q1. What is our independent variable? What is our dependent variable?

Independent Variable : The color / Word congruency being manipulated on the screen.

Dependent variable : The time it takes to read or name the color of the word on the screen.

Q2. Null and alternative hypotheses are clearly stated in words and mathematically. Symbols in the mathematical statement are defined.

- **T-test or Z-test** : A t-test is a more appropriate test in this case for the following reasons:
 1. : Population mean and population standard deviation is unknown
 2. : The test is a dependent samples test and we have the same participant's being tested under different conditions
 3. : An appropriate test would be a two tailed paired t-test
- **Null Hypothesis** : The null hypothesis will state that the times taken for a reader to read congruent letters vs the incongruent letters is the same and has no effect on the reading times
- **Alternate Hypothesis** : This hypothesis states that the times taken for a reader to read congruent letters is **DIFFERENT** from the incongruent letters.
- **Alpha Level** : 0.05

Mathematical Representation

$H_0 : u_D = u_2 - u_1 = 0$ (Null Hypothesis)

$H_A : u_D = u_2 - u_1 \neq 0$ (Alternative Hypothesis)

Here u_D is the difference in mean times between incongruent (u_2) and congruent (u_1) experiments. If u_D is substantially different than 0, we can say that the time taken to complete the incongruent experiment is significantly different from the congruent experiment, i.e reject the null hypothesis.

Symbolically this is represented as follows

$H_0 : P = 0.5$

$$H_A : P \neq 0.5$$

Q3. A statistical test is proposed which will distinguish the proposed hypotheses. Any assumptions made by the statistical test are addressed.

Technically, we have a hunch that it will take longer to read letters that state a color but are in different color and this would warrant an one tailed T-test in the positive direction. But in the real world, experiments rarely know which direction the test will need to be tested, so we will perform a **two tailed Paired T-test** here

Q4. 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.

Congruent task: 10.053 seconds

Incongruent task: 21.287 seconds

Q5. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.

- **Congruent Values :**

Mean : 14.051125 Median : 14.3565 Std Dev : 3.559357958

- **Incongruent Values :**

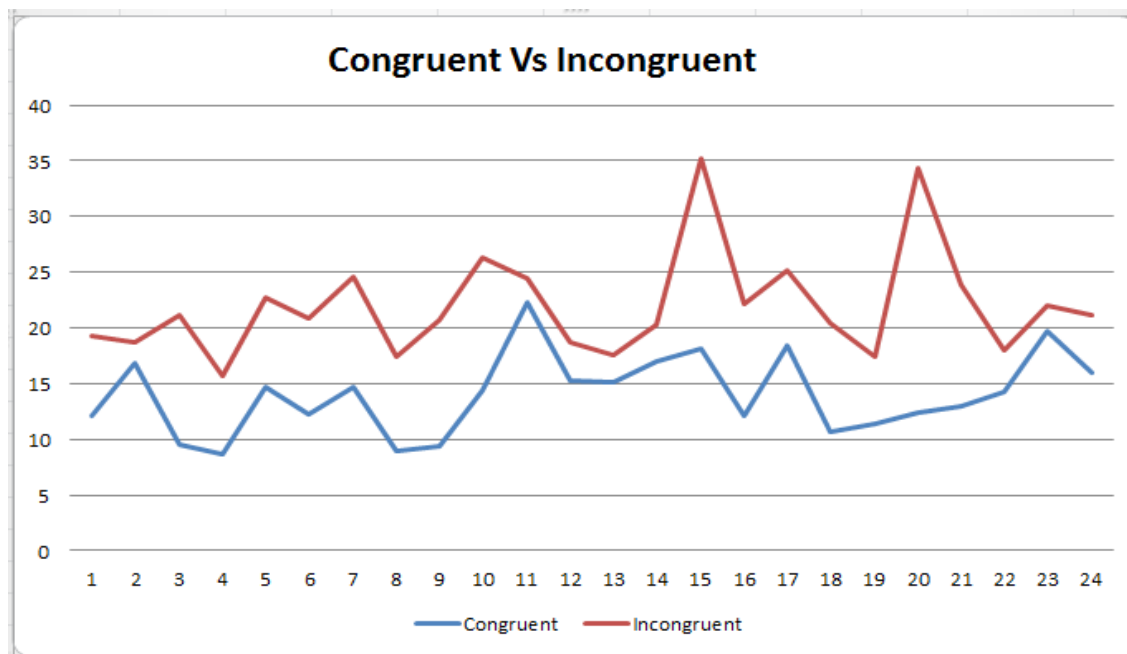
Mean : 22.01591667 Median : 21.0175 Std Dev : 4.797057122

- **Difference :**

Mean : -7.964791667 Median : -7.6665 Standard Deviation : 4.864

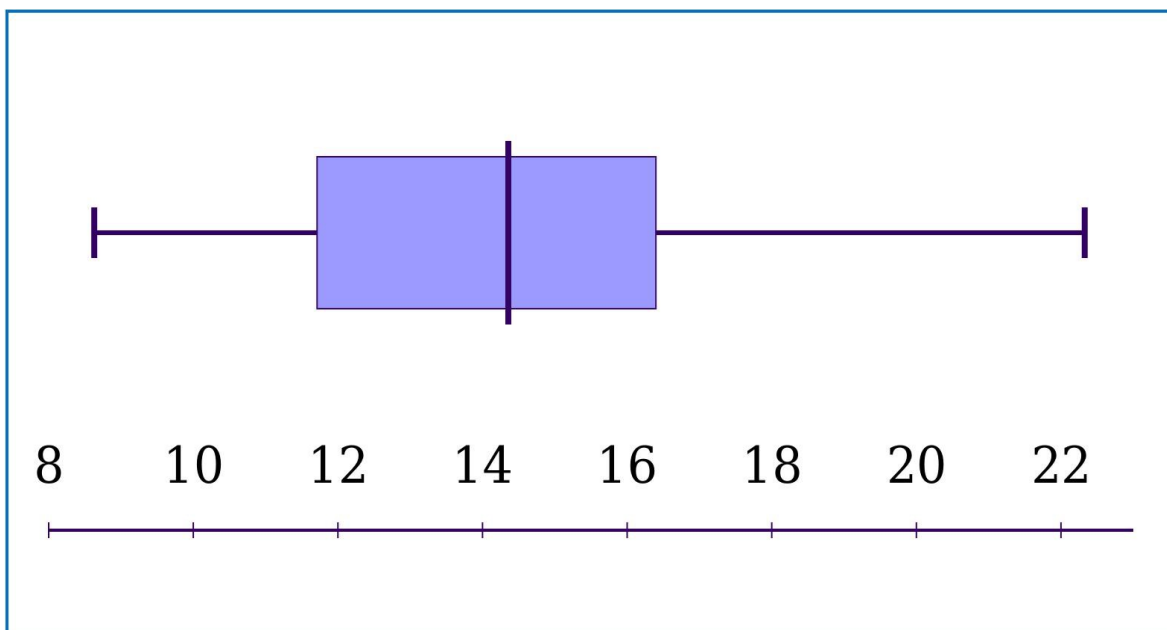
Q6. Provide one or two visualizations that show the distribution of the sample data. Write one or two sentences noting what you observe about the plot or plots.

Line Plot:

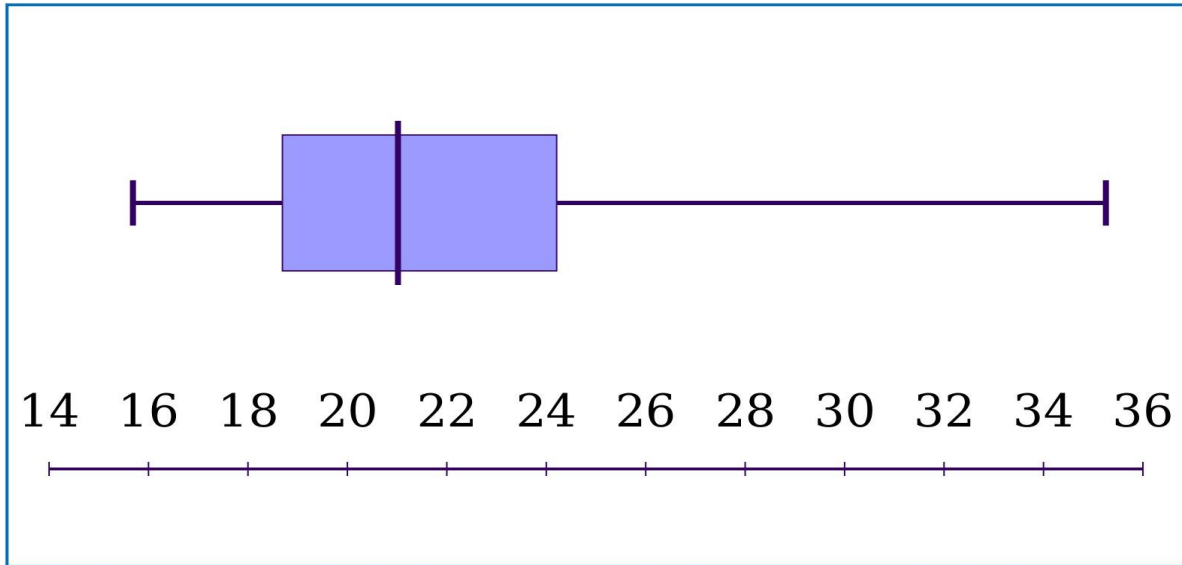


Box Plot :

Congruent:



Incongruent :



We can clearly see from the Box plot and the line graph above that it takes people longer to finish the incongruent words than the congruent one

Q7. 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?

From the values in the difference, we can calculate the Standard Error

Standard Error = Standard Deviation of Difference / Sqrt(Number of Observations)

Calculated Value = 2.0930

T Value = Mean Difference/Standard Error

Calculated Value = -8.02071

For 23 Degrees of Freedom and for an Alpha value of 0.05 : T Critical is + or - 2.0686

Confidence Interval = Mean of Difference + or - Margin of Error

Margin of Error = $t_{critical} * S.E$

Calculated Value = -24.55 to 8.62

As we can see, the T Statistic of the difference falls in the critical zone (Higher than T-Critical), so we have enough evidence to *REJECT THE NULL HYPOTHESIS*

CONCLUSION

The Time taken for reading the congruent words is different from the time taken for reading the incongruent words.