**Google sheet** -https://docs.google.com/spreadsheets/d/1xV7n2GqBCukKMlfeDA-83E_uY5y9nKXwkKlW2j9jAYM/edit?usp=sharing

1) Independent variable is the word being displayed in a color of ink i.e. with two conditions. Since, we are measuring the time it takes to name the ink colors in equally-sized lists, the dependent variable is Time.

2) Null Hypotheses - there is no significant difference in time taken to name the color of the ink in *congruent words* condition & *incongruent words* condition.

   ***H0*: Mean Time (*congruent*) =≈ Mean Time (*incongruent*)**

   *Or*

   **Mean Time (*congruent*) - Mean Time (*incongruent*) =≈ 0**

   Alternate Hypotheses - there is significant difference in time taken to name the color of the ink in *congruent words* condition & *incongruent words* condition.

   ***Ha*: Mean Time (*congruent*) ≠ Mean Time (*incongruent*)**

   *Or*

   **Mean Time (*congruent*) - Mean Time (*incongruent*) ≠ 0**

   We do not know the population parameters Mu and Sigma in this case, so we cannot perform z- test. We have only 2 samples from which we have to draw our conclusions. We would perform 2 sample t-test as we are comparing two samples which are dependent and the same subject (participant) is taking the Stroop test twice with different conditions i.e.

once with congruent words condition & other with incongruent words condition. This is a within subject design and each subject is assigned two conditions for which we have paired data.

3) Measure of Central Tendency – Mean

**Mean Time (*congruent*) = 14.051125**

**Mean Time (*incongruent*) = 22.01591667**

**Mean of the Differences of the respective times of both conditions i.e.**

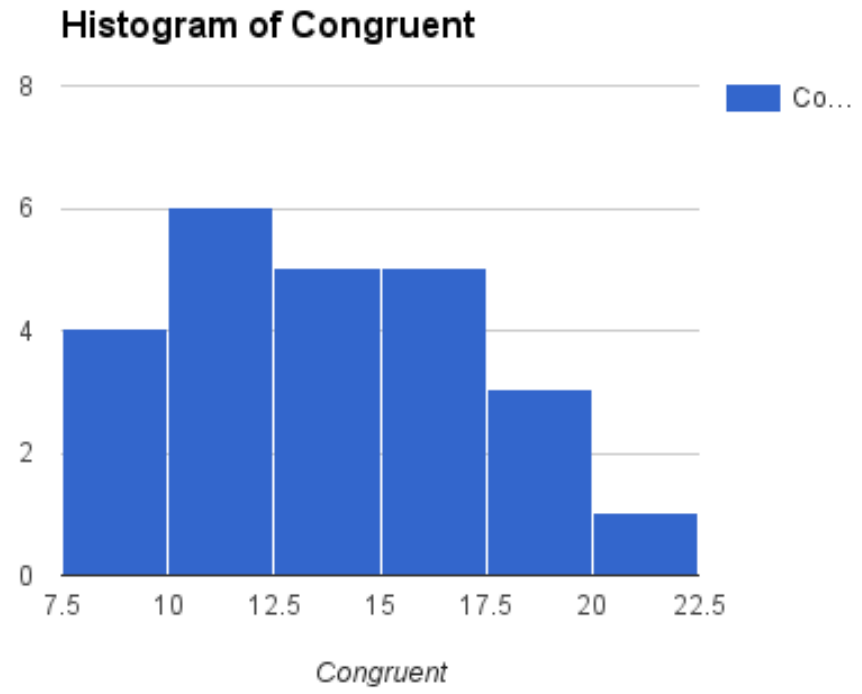
**Mean Difference = Mean Time (*congruent*) - Mean Time (*incongruent*) = -7.964791667**

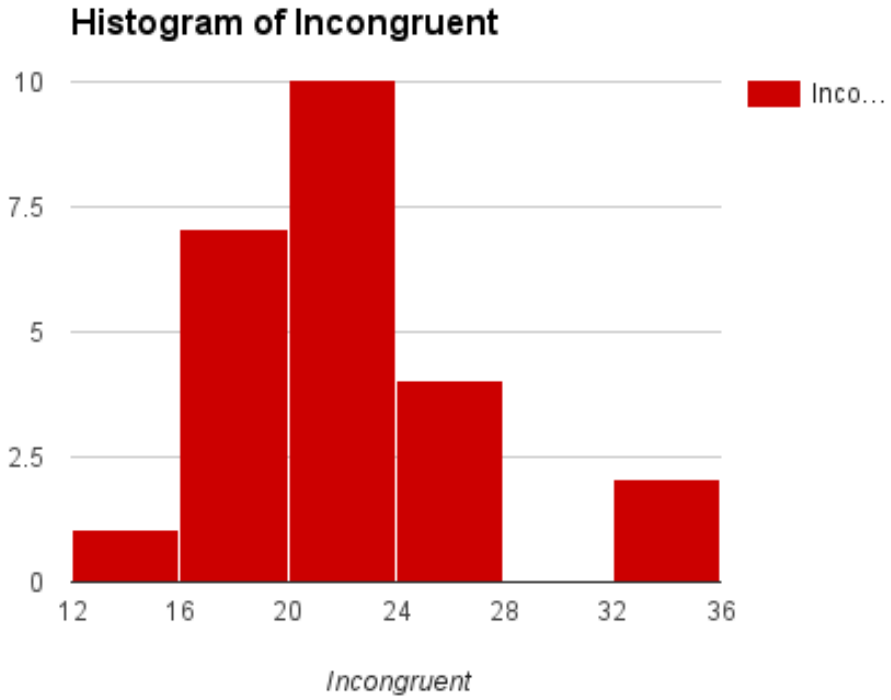
Measure of Variability – Standard Deviation

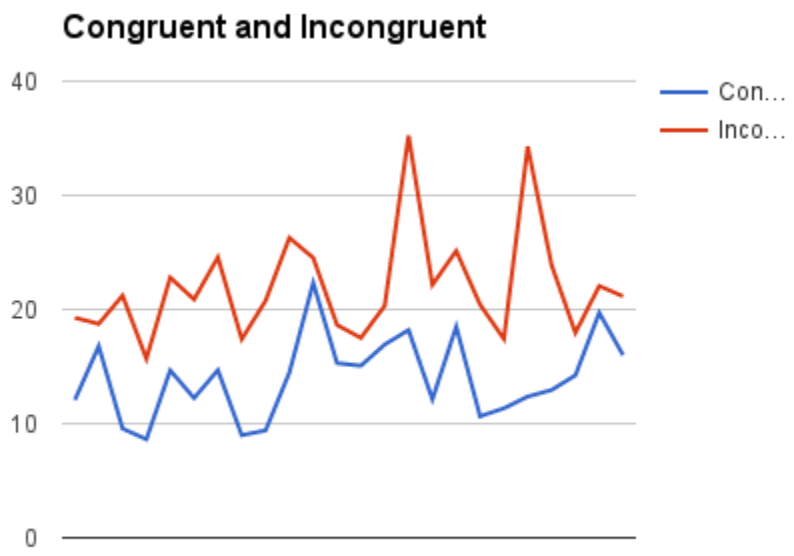
**Standard Deviation of Differences = 4.86482691**

**Standard Error of Mean Difference = 0.993028635**

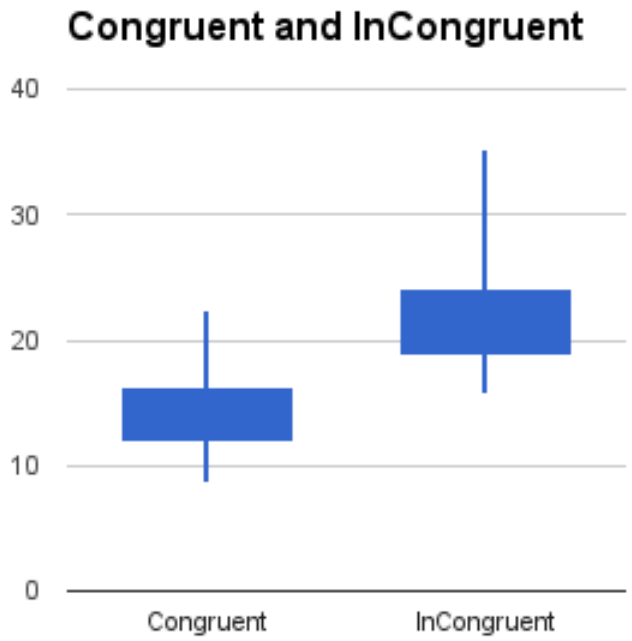
4) Distribution of the congruent sample data appears to be uniform whereas distribution of the incongruent sample data appears to be skinny normal distributed. In the middle of the distributions, participant's performance to stroop tasks get close and about to merge with both the conditions.


Histogram of Congruent
Co...
8
6
4
2
0
7.5
10
12.5
15
17.5
20
22.5
Congruent


Histogram of Incongruent
Inco...
10
7.5
5
2.5
0
12
16
20
24
28
32
36
Incongruent




In the below boxplot of the Congruent and Incongruent data, there appears to be large difference in the Min., Lower quartile, Upper Quartile, Median and Max. points.




5) Now,

$t_{value}$ = **Mean Time (*congruent*) - Mean Time (*incongruent*)**
**Standard Deviation of Mean Difference/√size of the sample**

**= -7.964791667**
**4.86482691/√24**

**= -8.020706944**

Taking **95 %** confidence level for 2 tailed t-test and for DF = 23, our t-*critical value* comes out to **±2.069** in the tails. Now, our $t_{value}$ is **-8.02** which is way far away from the mean and lies left of the -2.069 in the left tail in the low probability area of .025. **The two-tailed P value is less than 0.0001**.Therefore, we would **reject the null** in favor of the alternate i.e.
**Mean Time (*congruent*) ≠ Mean Time (*incongruent*)**
**i.e. there is significant difference in time taken to name the color of the ink in congruent words condition & incongruent words condition.**

**Also, since the Mean difference is negative, it indicates that the time taken to name the color of the ink in *incongruent words* condition is more than the *congruent words* condition.**

And yes, the result match the expectations as stroop task while incongruent words condition took significantly more time to get completed for me as well as indicated by the sample data.

**6)** The words themselves have a strong influence over our ability to say the color. The interference between the different information (what the words say and the color of the words) our brain receives causes a problem.

There are several theories used to explain the Stroop effect and are commonly known as 'race models'. This is based on the underlying notion that both relevant and irrelevant information are processed in parallel, but "race" to enter the single central processor during response selection. They are:

### Processing speed

This theory suggests there is a lag in the brain's ability to recognize the color of the word since the brain reads words faster than it recognizes colors. This is based on the idea that word processing is significantly faster than color processing. In a condition where there is a conflict regarding words and colors (e.g., Stroop test), if the task is to report the color, the word information arrives at the decision-making stage before the color information which presents processing confusion. Conversely, if the task is to report the word, because color information lags after word information, a decision can be made ahead of the conflicting information.

### Selective attention

The Selective Attention Theory that color recognition as opposed to reading a word, requires more attention, the brain needs to use more attention to recognize a color than to word encoding, so it takes a little longer. The responses lend much to the interference noted in the Stroop task. This may be a result of either an allocation of attention to the responses or to a greater inhibition of distractors that are not appropriate responses.

### Automaticity

This theory is the most common theory of the Stroop effect. It suggests that since recognizing colors is not an “automatic process” there is hesitancy to respond; whereas, the brain automatically understands the meaning of words as a result of habitual reading. This idea is based on the premise that automatic reading does not need controlled attention, but still uses enough attentional resources to reduce the amount of attention accessible for color information processing. Stirling (1979) introduced the concept of response automaticity. He demonstrated that changing the responses from colored words to letters that were not part of the colored words increased reaction time while reducing Stroop interference.

### Parallel distributed processing

This theory suggests that as the brain analyzes information, different and specific pathways are developed for different tasks. Some pathways, such as reading, are stronger than others, therefore, it is the strength of the pathway and not the speed of the pathway that is important. In addition, automaticity is a function of the strength of each pathway, hence, when two pathways are activated simultaneously in the Stroop effect, interference occurs between the stronger (word reading) path and the weaker (color naming) path, more specifically when the pathway that leads to the response is the weaker pathway

Another alternative can be **"Number Stroop" Effect Experiment, "Directional Stroop" Effect Experiment & "Animal Stroop" Effect Experiment.**

**List of resources referred –**


1) https://s3.amazonaws.com/udacity-hosted-downloads/t-table.jpg
2) http://www.graphpad.com/quickcalcs/
3) https://faculty.washington.edu/chudler/words.html#seffect
4) https://en.wikipedia.org/wiki/Stroop_effect