Project: Test a Perceptual Phenomenon

1. What is independent variable? What is dependent variable?
    - Independent Variable:
        - Color of the word : Congruent or not
    - Dependent Variables:
        - Time takes to name 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.

Hypothesis:

Null Hypothesis(Ho):

The mean time for reading the congruent words are equal to the mean time for reading incongruent words in the population. In another words, there is no significant difference in population means and it can be represented as:

H0: μC = μI

Alternative hypothesis (Ha):

The mean time for reading congruent words is different (not equal to) from the mean time to read incongruent words in the population. And there is significant difference between both the means in the population. It can be represented as:

HA: μC ≠ μI

where μ is the mean, the subscript of ‘C” indicates congruent mean and “I” indicates incongruent mean.

The recommended statistical test we should use for the Stroop experiment in a T-test as we don’t know the mean of the total population. However we have detailed data on a sampled group for both the congruent and incongruent tests. In addition, we only have a data set of 24 people in the sample making it more better to use T-test to calculate our statistical test.

Type of the Test:

A two-tailed, dependent samples t-test comparing the difference in means (the time to name the ink colors for congruent words and incongruent words) should be performed. With this test, we seek to determine whether there is enough evidence in the provided sample of data to infer that the congruent words mean colour recognition time is different from the incongruent words mean colour recognition time for the entire population and not just the sample data.

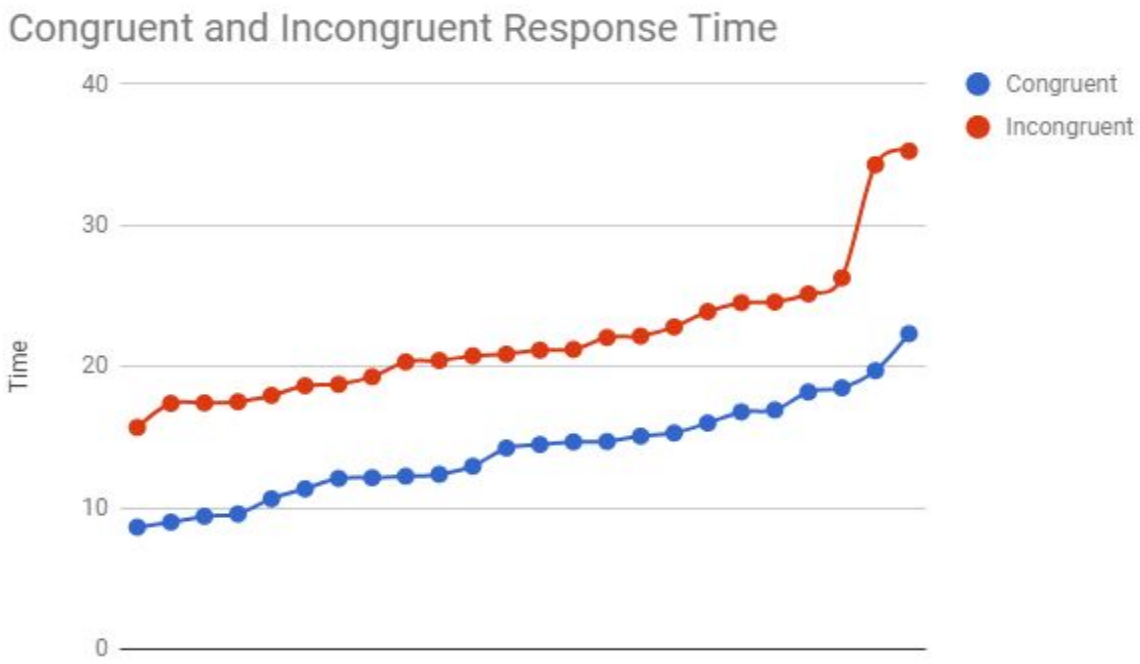
- Dependant paired samples t-test is appropriate because the
    - population variance is unknown
    - 2 sets of values are the values for 2 conditions on the same set of participants
- A two-tailed test is appropriate as we need to evaluate a non-directional condition.

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

Statistic	Congruent(C)	Incongruent(I)	Difference(D)
n	24	24	24
$\bar{x}$	14.05	22.02	-7.9648
Median	14.36	21.02	25.9450
Ss (S- square)	12.67	23.01	544.3304
s	3.56	4.80	4.8648

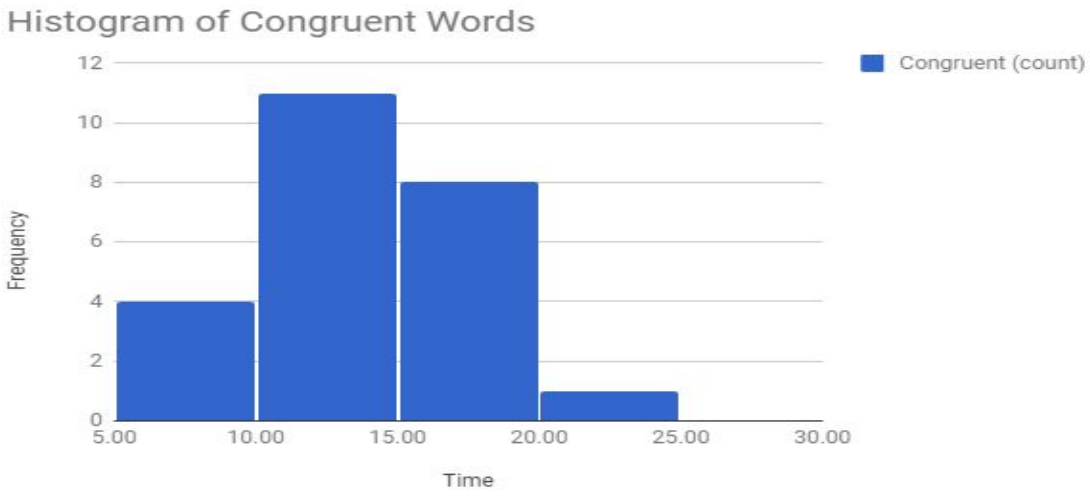
4. Provide one or two visualizations that show the distribution of the sample data. Write one or two sentences noting what you observe about the plot or plots?

- ***Comparison on Response Time for Congruent and Incongruent words:***

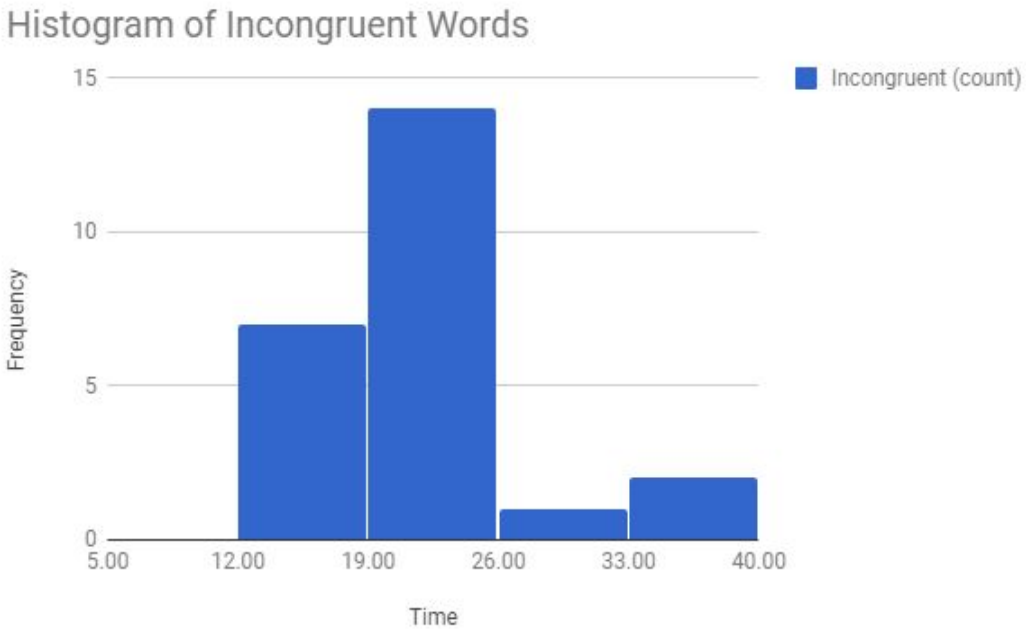


The line flow which connect the values of Square(X-Xbar) give us an idea on how the deviation of values from the middle of the line for both congruent and incongruent. For congruent words the deviation seeme less as the values stay closer the middle portion. But incongruent Some of the values are staying far away from the middle values.

- ***Response Time for Congruent:***



- ***Response Time for Incongruent:***



Another means to visualize the data can be done through a histogram which categorizes the data into frequencies to see how the data falls proportionally within ranges and gives us an approximation of the shape of the data's distribution.

The congruent histogram with normal curve shows a mild right skew (mainly because there are a few data points that are beyond 20 seconds). The congruent histogram if ignoring the tail beyond 20

seconds resembles closely to a normal distribution curve. The congruent histogram shows mainly the majority of the recorded times for the congruent test falls between 10 to 20 seconds.

The incongruent histogram with normal curve shows a firmer right-skewed distribution with connected data showing the majority of the times recorded falls between 15 to 30 seconds.

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?

α = .05, confidence Level = 95%

df = 23

t_{crit} = +/- 2.069

t (Statistics) = +/- 8.0209

p-value < .05

Decision: *Reject Ho*

- as the T(stat) is in the critical region and the p < .05 (The two-tailed P value is less than 0.0001) and it is considered as extremely statistically significant.

At the 95% confidence level (α = .05) and 23 degrees of freedom, the critical t value for a two-tailed test +/- 2.069. The calculated t-statistic for the difference in colour recognition time means of the congruent and incongruent word data is +/-8.0209. Since the t-statistic is in the critical region, the null hypothesis is rejected. Since the P value is less than .0001, it is considered to be extremely statistically significant.

There is sufficient evidence at the α = .05 level of significance to support the claim that the time taken for both the cases are significantly different.

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!

My hypothesis for the effects observed is that the brain dominantly focuses on reading the word rather than recognizing a colour when the eyes are presented with a coloured word. To recognize a colour, one has to override the brain's natural tendency of reading the word. This override takes time and is likely not always successful, which means re-analyzing a word after the error is recognized, which costs more time.

The same scenario can occur in Numerical/Physical size Stroop tasks, where numerical values and physical size are the factors that contribute to congruence and incongruence. It takes longer time to recognize the number and physical size (two separate tasks) of small numbers that have a large physical size and large numbers that have a small physical size. In both the examples the evaluation on mismatches are taking more time.