# Statistics: The Science of Decisions

## Stroop Effect

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

Ans :

**Independent Variable** - Congruent words condition and Incongruent words condition .
**Dependent Variable** - The time it takes to name the ink colors in Congruent and Incongruent Condition .

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

Ans:

**Hypotheses** -

**H0**: There will be no difference in time to name the colors in Congruent and Incongruent Condition.

$$\mu c = \mu i \quad \text{i.e , } \mu c - \mu i = 0$$

**H1**: There will be difference in time to name the colors in Congruent and Incongruent Condition.

$$\mu c - \mu i \neq 0$$

Where ,

μc - population mean for congruent condition.

μi - population mean for incongruent condition.

**Statisctical Test** -

- Kind of Test : **Dependent t-test**

The dataset provided is for the sample . As population parameters are not provided , t-test is used. The people who took the congruent words condition also took the incongruent words condition. Therefore , we can say that the kind of t-test to be performed is Dependent t-test.

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

Ans:

Link to the DataSet - https://drive.google.com/file/d/0B9Yf01UaIbUgQXpYb2NhZ29yX1U/view

| Central Tendency | Congruent Condition | Incongruent Condition |
|---|---|---|
| Mean | 14.05 | 22.02 |
| Median | 14.36 | 21.02 |

**Measure of Variability** - Variance and Sample Standard Deviation .

Sample Standard deviation Formula

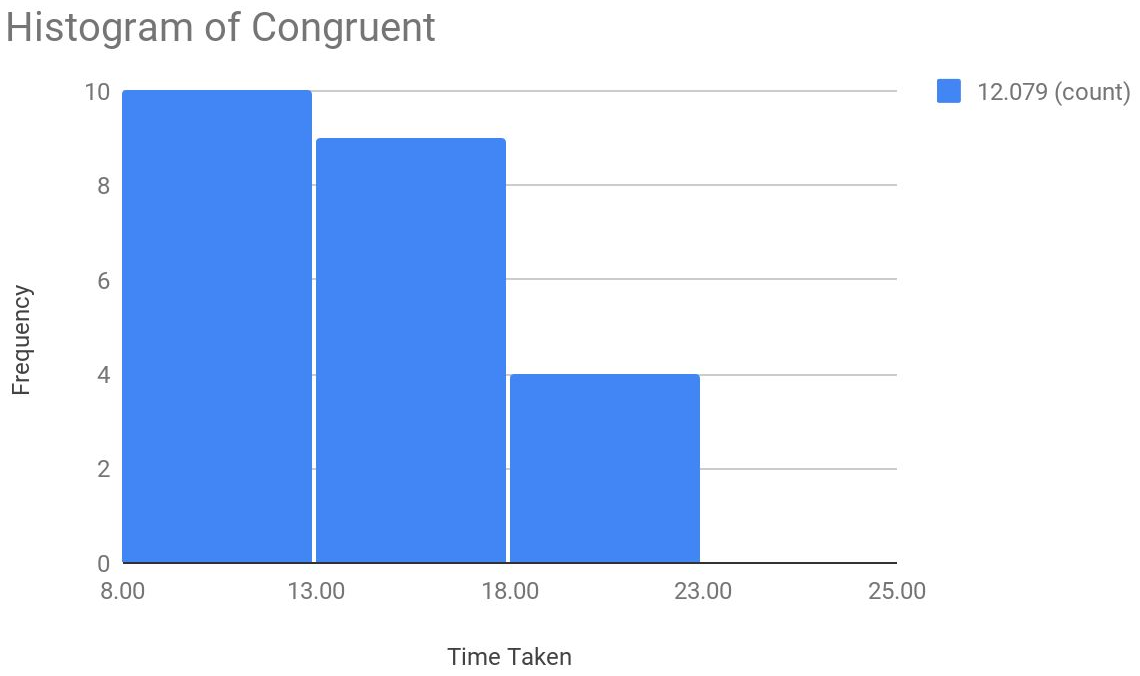
$$s_x = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

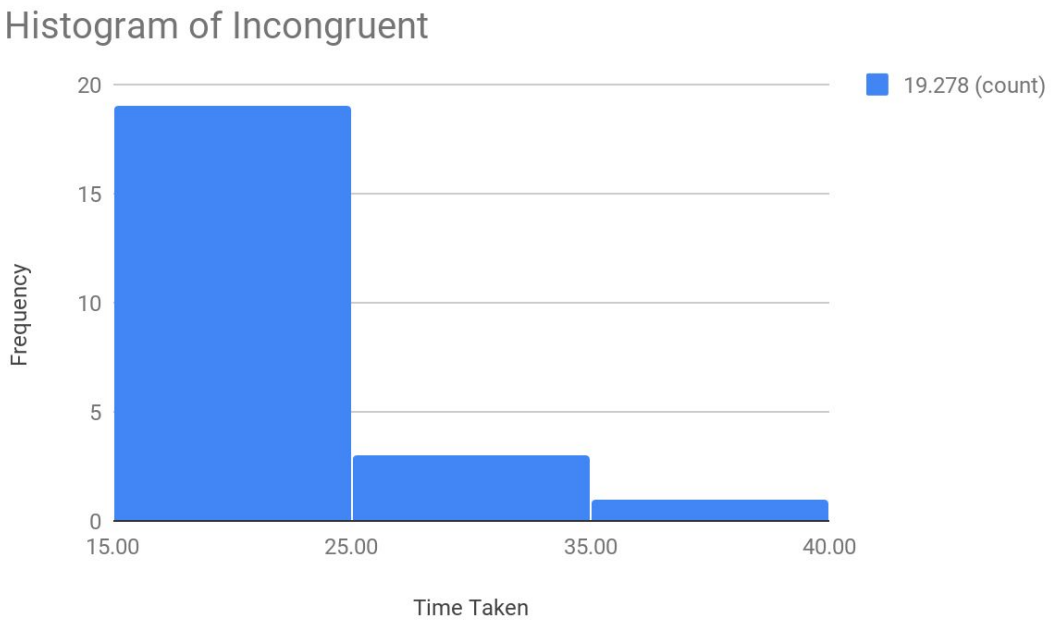
Variance = ( Sample Standard deviation ) ^2

| Measure of Variability | Dependent Sample |
|---|---|

| | |
|---|---|
| Variance | 23.67 |
| Standard deviation | 4.86 |

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 Congruent and Incongruent Histograms are Positively Skewed .The time taken by the participants in both the conditions fall toward the lower side of the scale and there are very less number of higher values.

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?

Ans :

The below calculations are for a **two - tailed test** and **α = .05**

| | **Formula** | **Value** |
|---|---|---|
| n | - | 24 |
| Degrees of Freedom (df) | n-1 | 24 - 1 = 23 |
| Sample Standard Deviation (S) | $s_x = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$ | 4.86 |
| Standard Error Mean | S/√n | 0.99 |

| | | |
|---|---|---|
| t- Statistic | (Mean Differences/Standard Error Mean) | -8.05 |
| t- Critical | - | +2.069 or -2.069 |
| Cohen's - D | Mean differences / S | -1.64 |
| $r^2$ | $t^2/(t^2 + df)$ | .73 |
| Margin of Error | t critical * Standard Error Mean | 2.04 |
| Confidence Interval (95% CI) | Mean differences ± Margin of Error | ( -10.01 , -5.93 ) |

From the Above Calculations we see that **p < .05** , hence we **reject the null(H0)** .

I conclude that people take more time in Incongruent Test than in Congruent test , because in case of Congruent Test - the words being displayed are color words whose names match the colors in which they are printed , as a result it easier for the person to say out loud the *color of the ink* in which the word is printed . Thus reducing the amount of time .

In case of Incongruent Test - the words displayed are color words whose names do not match the colors in which they are printed , as a result it takes more time for the person to say out loud the *color of the ink* in which the word is printed .Thus taking more time than the Congruent Test .

Therefore the time taken in Congruent Condition and Incongruent Condition cannot be the same and results also match up to my expectations as we reject the null hypotheses .

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!

Ans:

Participant taking less time in congruent condition than in incongruent condition .The reason for the effects observed is of the more time taken by the human brain in a person because of the contradiction in the color words and the colors in which they are printed.

Alternative Task / Similar Task -

Time taken by person to say the Alphabets from [A - Z] i.e in Alphabetical Order and time taken by the same person to say the Alphabets in reverse order .

The time taken to say the Alphabets in alphabetical Order is less than the time taken to say the Alphabets in reverse Order .This task is similar to the congruent and Incongruent condition.

**Reference Used -**

- Udacity's Chapter on **Descriptive Statistics**

**Descriptive Statistical Calculations -**

https://docs.google.com/document/d/1xMWGDy3cfwsGeVbhue5tXMubmRF_fjIr7vbeQJX9gtU/edit?usp=sharing