**Stroop Task**

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Table of Contents

[Question 1: Independent and Independent variables 1](#_Toc483668875)

[Question 2: Hypotheses and Test 1](#_Toc483668876)

[Question 3: Descriptive Statistics 2](#_Toc483668877)

[Question 4: Data Visualization 3](#_Toc483668878)

[Question 5: Statistical Test 5](#_Toc483668879)

[Question 6: Optional 6](#_Toc483668880)

[Works Cited 6](#_Toc483668881)

## Question 1: Independent and Independent variables

In the Stroop task project one can identify the independent and dependent as follow:

Independent variable: Word formats, congruent and incongruent.

Dependent variable: Performance, time to name the ink colors.

On the other words, the word formats are on the x axis, while the performances are on the y axis.

## Question 2: Hypotheses and Test

Since we want to see if the performance is significantly affected by the difference in word formats, we can formulate the hypotheses as follow:

HO: μcong - μincong = 0

HA: μcong - μincong ≠ 0

The Ho states that the population does not have significantly different performance means between congruent and incongruent. On the opposite, the alternative hypothesis states that there is significant difference between congruent and incongruent population mean.

To determine the appropriate hypothesis testing to be used, some important specifics of the Stroop test are listed as follow.

1. There is no population standard deviation and mean data available
2. The subjects take test twice because the same sample receives two treatments.

Considering the facts above, dependent t-test will be used to determine if the two sets of data (congruent and incongruent) are significantly different from each other.

## Question 3: Descriptive Statistics

Table 1 shows the raw data of the Stroop test result. There are twenty-four subjects, and the values indicate the time taken in second to complete the test.

By using Excel, we can generate the descriptive statistics of the data sets. Table 2 illustrates the statistics of each sample.

Table : Raw Data

| Congruent | Incongruent |
| --- | --- |
| 12.079 | 19.278 |
| 16.791 | 18.741 |
| 9.564 | 21.214 |
| 8.63 | 15.687 |
| 14.669 | 22.803 |
| 12.238 | 20.878 |
| 14.692 | 24.572 |
| 8.987 | 17.394 |
| 9.401 | 20.762 |
| 14.48 | 26.282 |
| 22.328 | 24.524 |
| 15.298 | 18.644 |
| 15.073 | 17.51 |
| 16.929 | 20.33 |
| 18.2 | 35.255 |
| 12.13 | 22.158 |
| 18.495 | 25.139 |
| 10.639 | 20.429 |
| 11.344 | 17.425 |
| 12.369 | 34.288 |
| 12.944 | 23.894 |
| 14.233 | 17.96 |
| 19.71 | 22.058 |
| 16.004 | 21.157 |

Table : Descriptive Statistics

|  |  |  |  |
| --- | --- | --- | --- |
| *Congruent* |  | *Incongruent* |  |
|  |  |  |  |
| Mean | 14.051125 | Mean | 22.01591667 |
| Standard Error | 0.726550901 | Standard Error | 0.979195185 |
| Median | 14.3565 | Median | 21.0175 |
| Mode | #N/A | Mode | #N/A |
| Standard Deviation | 3.559357958 | Standard Deviation | 4.797057122 |
| Sample Variance | 12.66902907 | Sample Variance | 23.01175704 |
| Kurtosis | -0.205224823 | Kurtosis | 2.688900198 |
| Skewness | 0.416899874 | Skewness | 1.547590026 |
| Range | 13.698 | Range | 19.568 |
| Minimum | 8.63 | Minimum | 15.687 |
| Maximum | 22.328 | Maximum | 35.255 |
| Sum | 337.227 | Sum | 528.382 |
| Count | 24 | Count | 24 |
| Largest(1) | 22.328 | Largest(1) | 35.255 |
| Smallest(1) | 8.63 | Smallest(1) | 15.687 |
| Confidence Level(95.0%) | 1.50298505 | Confidence Level(95.0%) | 2.025619571 |

## Question 4: Data Visualization

As we can see from Figure 1 and Figure 2, the samples histogram charts are more less following the normal curve. The incongruent histogram has more positive skewness, however as also shown in descriptive statistics section, the mean and median of each sample are close.

|  |  |
| --- | --- |
|  |  |
| *Bin* | *Frequency* |
| 8 | 0 |
| 9.96 | 4 |
| 11.91 | 2 |
| 13.87 | 5 |
| 15.83 | 6 |
| 17.78 | 3 |
| 19.74 | 3 |
| 21.70 | 0 |
| 23.65 | 1 |
| More | 0 |

Figure : Histogram - Congruent

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | |  | | |
|  | | |  | | |  |  |
| *Bin* | | *Frequency* | | |
| 15 | | 0 | | |
| 17.80 | | 4 | | |
| 20.59 | | 6 | | |
| 23.39 | | 7 | | |
| 26.18 | | 4 | | |
| 28.98 | | 1 | | |
| 31.77 | | 0 | | |
| 34.57 | | 1 | | |
| 37.36 | | 1 | | |
| More | | 0 | | |

Figure : Histogram - Incongruent

## Question 5: Statistical Test

As mentioned in Question 2 section above, we use the t-test determine if we can reject Ho or not. The confidence level is 95%, thus the α is 0.05. One tail test is used since we know that it always takes more time for subjects to do the incongruent test compared to the congruent one. Again, we leverage Excel’s Data Analysis tool to perform dependent t-test, specifically, the t-test paired two sample for means.

Running the test for the dataset, we get the result as follow.

Table : t-Test: Paired Two Sample for Means

|  |  |  |
| --- | --- | --- |
|  | *Congruent* | *Incongruent* |
| Mean | 14.051125 | 22.01591667 |
| Variance | 12.66902907 | 23.01175704 |
| Observations | 24 | 24 |
| Pearson Correlation | 0.351819527 |  |
| Hypothesized Mean Difference | 0 |  |
| df | 23 |  |
| t Stat | -8.020706944 |  |
| P(T<=t) one-tail | 2.0515E-08 |  |
| t Critical one-tail | 1.713871528 |  |
| P(T<=t) two-tail | 4.103E-08 |  |
| t Critical two-tail | 2.06865761 |  |

Because the P(t) value is 2.0515E-08 which is much smaller than α value 0.05, there is enough evident reject Ho and we can conclude that there is significant performance difference between congruent and incongruent.

## Question 6: Optional

One of the theories that try to explain this observed effect is processing speed. According to this theory, brain reads the words significantly faster than it recognizes colors. Whenever there is conflict regarding the words and colors (incongruent), and the task is to report the color, the word information arrives at the decision making stage before the color information, thus creating processing confusion. If the task is to report the word, the decision making can quickly proceed without confusion.

The research can be replicated and extended. For example, rather than using the color words, we can use non-sense words and examine if the difference is still significant. Will the brain focus better on the color if the words do not have meanings?

# Works Cited

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