# Statistics: The Science of Decisions Project Instructions

## Background Information

In a Stroop task, participants are presented with a list of words, with each word displayed in a color of ink. The participant's task is to say out loud the *color of the ink* in which the word is printed. The task has two conditions: a congruent words condition, and an incongruent words condition. In the *congruent words* condition, the words being displayed are color words whose names match the colors in which they are printed: for example RED, BLUE. In the *incongruent words* condition, the words displayed are color words whose names do not match the colors in which they are printed: for example PURPLE, ORANGE. In each case, we measure the time it takes to name the ink colors in equally-sized lists. Each participant will go through and record a time from each condition.

## Questions for Investigation

As a general note, be sure to keep a record of any resources that you use or refer to in the creation of your project. You will need to report your sources as part of the project submission.

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

   Independent Variable: Words displayed for congruent and incongruent words list.
   Dependent Variable: Time observed for congruent and incongruent words list

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

   The original study suggests that time taken to observe by participants in Incongruent set of words is more than in Congruent set of words. On the basis of original study, and analysis of sample data we will reject or accept the hypothesis.

   Population Mean of Congruent word with: $\mu_C$
   Population Mean of Incongruent words with: $\mu_I$

| Null Hypothesis | Alternative Hypothesis |
|---|---|
| $H_0: \mu_C - \mu_I = 0$ | $H_A: \mu_C - \mu_I < 0$ |
| The difference between population mean of two data sets will be zero | The difference between congruent and incongruent population data will be less than zero for one tail, left, t-test at α=.05. |

   In order to decide to do a z-test or t-test we will discuss if we have to analyze if we have population standard deviation σ, and the sample size.

Z-test is usually performed with samples where we know standard deviation σ of the universal data set (U), whereas t-test are performed with small sample size(X) and the population standard deviation σ is not known.
Sample size= number of participants =24
The sample data set contains limited set of data, sample size is less than 30, Congruent and Incongruent data set.

| Std Dev σ (U) | Sample Size(X) | z-test | t-test |
|---|---|---|---|
| Population standard deviation not known | 24 < 30 | No | Yes(Paired) due to dependent sample data |

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

| DF | Avg. Cong | Avg. Incng | Std. Dev Cong | Std. Dev. Incong | Standard Error | Std. Dev of differences |
|---|---|---|---|---|---|---|
| 23 | 14.051125 | 22.01591667 | 3.559358 | 4.797057 | 0.9930286 | 4.864827 |

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.
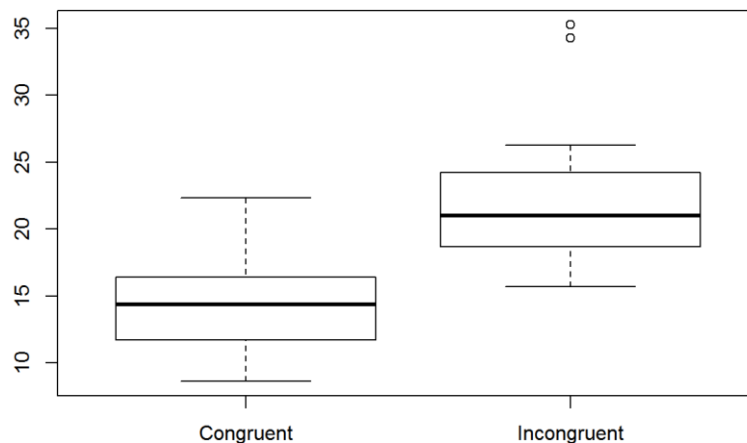


Boxplot of Congruent and Incongruent time observation indicate that there are two outliers in incongruent data. The range for congruent data sample set is (8.6, 22.4) and range for Incongruent data sample set is (15.6, 26.3). By looking at the range of both data sets we can say that the average difference between two data samples set is also not zero.

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?

| t-statistics | Degree of Freedom | t-critical at α = .05 one tail | p-value | Result |
|---|---|---|---|---|
| **-8.0207** | 23 | -1.713872 | 2.052e-08 | Reject Null Hypothesis |

The result is significant at alpha level .05 where t-statistics is less than t-critical value
$\mu_C - \mu_I < 0$. Therefore we reject the null hypothesis that $\mu_C - \mu_I = 0$

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!

We expect that the result will be same in both conditions. However, brain works differently in each condition. It's easier to recognize color in congruent list of words whereas, brain struggles with incongruent sets of words. There have been other Stroop tests similar to color Stroop tests, such as warped word Stroop test which are used in identifying human or robot in logging in to any site. The brain slows down to identify the word; however, when a word is given without being warped, brain reads it without any difficulty.