TEST A PERCEPTUAL PHENOMENON

INTROUCTION

Stroop effect is an experiment in psychology which was conducted by John Ridley Stroop that he used to demonstrate the interference in the reaction time of a task. More Specifically to explain, a list of words is displayed in different color of ink to the participants of the experiment. The participant must read out loud the color of the ink the word is displayed in. Now, the words displayed in two different conditions, namely Congruent word condition and incongruent word condition. In the congruent word condition, the word displayed are the color names that match the displayed color and the incongruent word condition is quite the opposite, in which, the color name is displayed in a different color ink. Each participant is displayed a word in both the conditions and the time taken for the participant to read it out loud are noted separately for the two conditions.

The below image represents the Stroop effect. The first half of the image is the congruent word condition and the second half is the incongruent condition.

INVESTIGATION

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

Independent variable- It is the word condition – Congruent word condition and Incongruent word condition

Dependent variable – The time taken for the participant to read out the color of the ink in both the conditions

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:

The following are the two hypotheses to be used in the hypothesis testing.

1. Null Hypothesis H_0 – There will be no effect or the time taken to read the mismatched color to color name. (H_0: $\mu_i \leq \mu_c$)
2. Alternate Hypothesis H_1 – There will be an increase in the time taken to read the mismatched color to the color name. (H_1: $\mu_i > \mu_c$)

Where,

μ_i – is the mean of the experiment in incongruent word condition

μ_c – is the mean of the experiment in congruent word condition

From the Hypothesis testing criteria, a paired one tailed t-test for a 95% confidence interval will be the best choice of testing to find out if there is a statistically significant difference between the time taken for the participants to recognize color of the ink at an alpha level of 0.05. A one directional t- test is preferred because the population standard deviation is not known and the sample data size is less than 30.

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

In the following step, I have loaded the Stroop Effect data in R to report some descriptive statistics.

```
StroopData = read.csv('stroopdata.csv')

StroopData
```

```
##    Congruent Incongruent
## 1     12.079     19.278
## 2     16.791     18.741
## 3      9.564     21.214
## 4      8.630     15.687
## 5     14.669     22.803
## 6     12.238     20.878
## 7     14.692     24.572
## 8      8.987     17.394
## 9      9.401     20.762
## 10    14.480     26.282
```

```
## 11   22.328    24.524
## 12   15.298    18.644
## 13   15.073    17.510
## 14   16.929    20.330
## 15   18.200    35.255
## 16   12.130    22.158
## 17   18.495    25.139
## 18   10.639    20.429
## 19   11.344    17.425
## 20   12.369    34.288
## 21   12.944    23.894
## 22   14.233    17.960
## 23   19.710    22.058
## 24   16.004    21.157
```

To find the mean and median, the describe function of the Psych Package is useful. From the below results,

μ_i = 22.02 - (Mean of the experiment in incongruent word condition)

μ_c = 14.05 - (Mean of the experiment in Congruent word condition

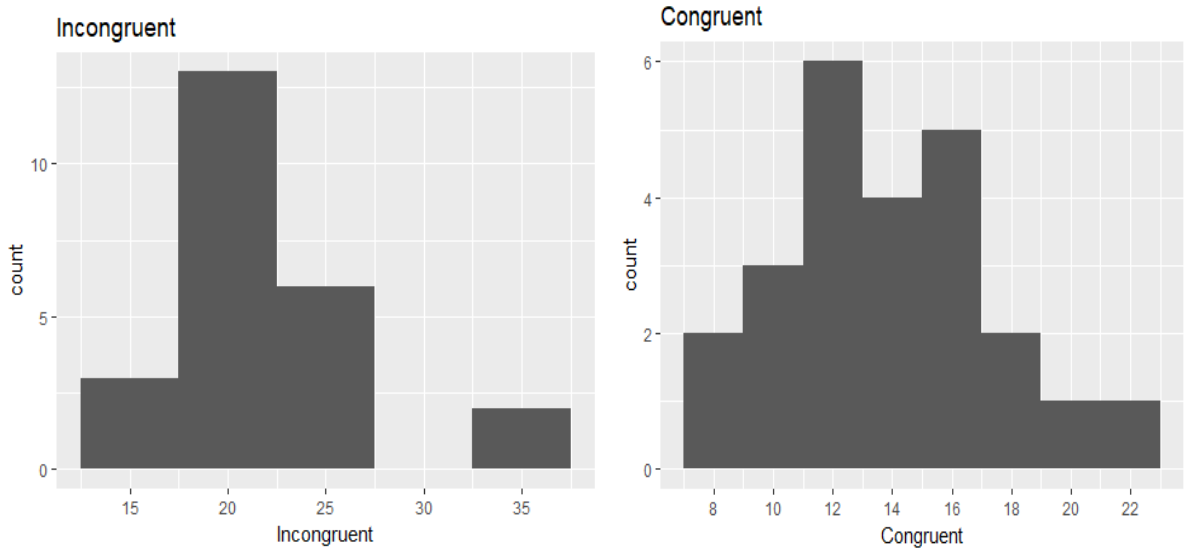
σ_i = 4.80 - (Standard Deviation of the experiment in incongruent word condition)

σ_c = 3.56 - (Standard Deviation of the experiment in Congruent word condition

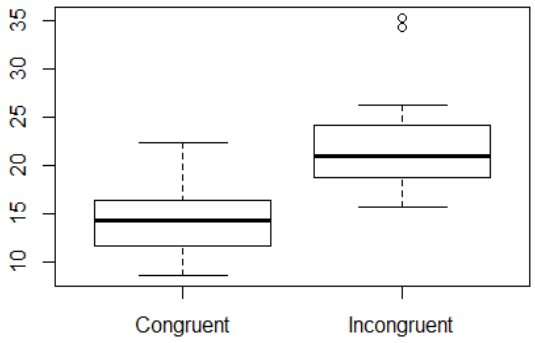
```
library(psych)

describe(StroopData)

##             vars  n  mean   sd median trimmed  mad   min   max range skew
## Congruent      1 24 14.05 3.56  14.36   13.88 3.49  8.63 22.33 13.70 0.37
## Incongruent    2 24 22.02 4.80  21.02   21.29 3.89 15.69 35.26 19.57 1.36
##             kurtosis   se
## Congruent      -0.62 0.73
## Incongruent     1.52 0.98

median(StroopData$Congruent)

## [1] 14.3565

median(StroopData$Incongruent)

## [1] 21.0175

mean(StroopData$Congruent)

## [1] 14.05113

mean(StroopData$Incongruent)

## [1] 22.01592
```

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

```
## library(ggplot2)

ggplot(data = StroopData, aes(Congruent)) +  geom_histogram(binwidth = 2)  +
scale_x_continuous(breaks = seq(0, 30, 2)) + ggtitle('Congruent')

ggplot(data = StroopData, aes(Incongruent)) +  geom_histogram(binwidth = 5)  +
  scale_x_continuous(breaks = seq(0, 40, 5))+ ggtitle('Incongruent')
```




```
boxplot(StroopData)
```



The data distribution from the histogram and bar ploy of both the congruent and incongruent word condition tells us that the mean of the time taken in congruent word condition seems to be lesser than the incongruent condition. Also, there are two outliers in the incongruent condition.

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? Conclude in terms of the experiment task. Did the results match up with your expectations?

To Perform the t-test, I have used the t.test function from the TeachingDemos library in R.

```
library(TeachingDemos)


t.test( StroopData$Incongruent, StroopData$Congruent, paired = TRUE, alternative = c("greater"))

##
##  Paired t-test
##
## data:  StroopData$Incongruent and StroopData$Congruent
## t = 8.0207, df = 23, p-value = 2.052e-08
## alternative hypothesis: true difference in means is greater than 0
## 95 percent confidence interval:
##  6.262868      Inf
## sample estimates:
## mean of the differences
##              7.964792
```

From the code output,

t-statistic = 8.0207

Degrees of freedom = 23

p- Value = 2.052e-08

For a 95% confidence interval the significance value, α = 0.05. Since the p-value(2.052e-08) is less than alpha, **we reject the null hypothesis** and can conclude that the time taken by the participant to read out a word in Incongruent condition will be greater than the time taken by the participant to read out a word in Congruent condition.

References

https://en.wikipedia.org/wiki/Stroop_effect

https://www.statmethods.net/stats/ttest.html

http://www.sthda.com/english/wiki/paired-samples-t-test-in-r