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?

   The independent variable in this experiment is the font color as well as the word name itself.

   The dependent variable in this experiment is the time it takes for the participant to react and correctly identify the color of the ink that the word is printed.

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 null hypothesis of this experiment is that there is a normal distribution within the reaction times. The null hypothesis can also be stated for the population means (μ): Congruent μ = Incongruent μ. The alternative hypothesis is that there is not a normal distribution within the reaction times as well as the population means between the Congruent and Incongruent conditions will not be equal.

   Shapiro-Wilk Normality Test is a statistical test that can be used in this experiment because the participant size is 23, which fits between the guidelines of a Shapiro-Wilk Test and will return a Wilk score as well as the p-value which will assist in determining if the null hypothesis should be rejected because it will test the null hypothesis would state that there is a normal distribution within the reaction times. The alternative hypothesis would then say there is not a normal distribution within the reaction times. When the statistical test is performed on this data and the p value is less than 0.05, the null hypothesis would then be rejected because that would signify there is not a normal distribution within the data.

Resource: http://analyse-it.com/blog/2008/8/testing-the-assumption-of-normality

Now it's your chance to try out the Stroop task for yourself. Go to this link, which has a Java-based applet for performing the Stroop task. Record the times that you received on the task (you do not need to submit your times to the site.) Now, download this dataset which contains results from a number of participants in the task. Each row of the dataset contains the performance for one participant; with the first number their results on the congruent task and the second number their performance on the incongruent task.

My Results:
Congruent Condition: 9.873 seconds
Incongruent Condition: 19.874 seconds

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

Central tendency measures:
Congruent Mean – 14.051 seconds
Incongruent Mean – 22.016 seconds
Congruent Median – 14.357 seconds
Incongruent Median – 21.018 seconds
Congruent Mode – There is no mode for this dataset
Incongruent Mode – There is no mode for this dataset
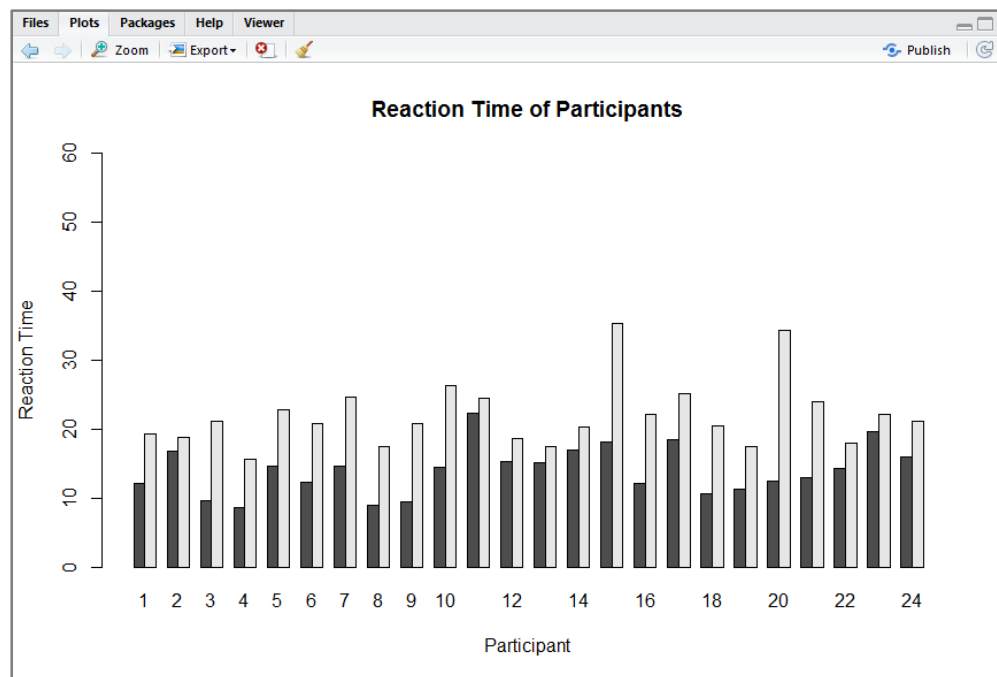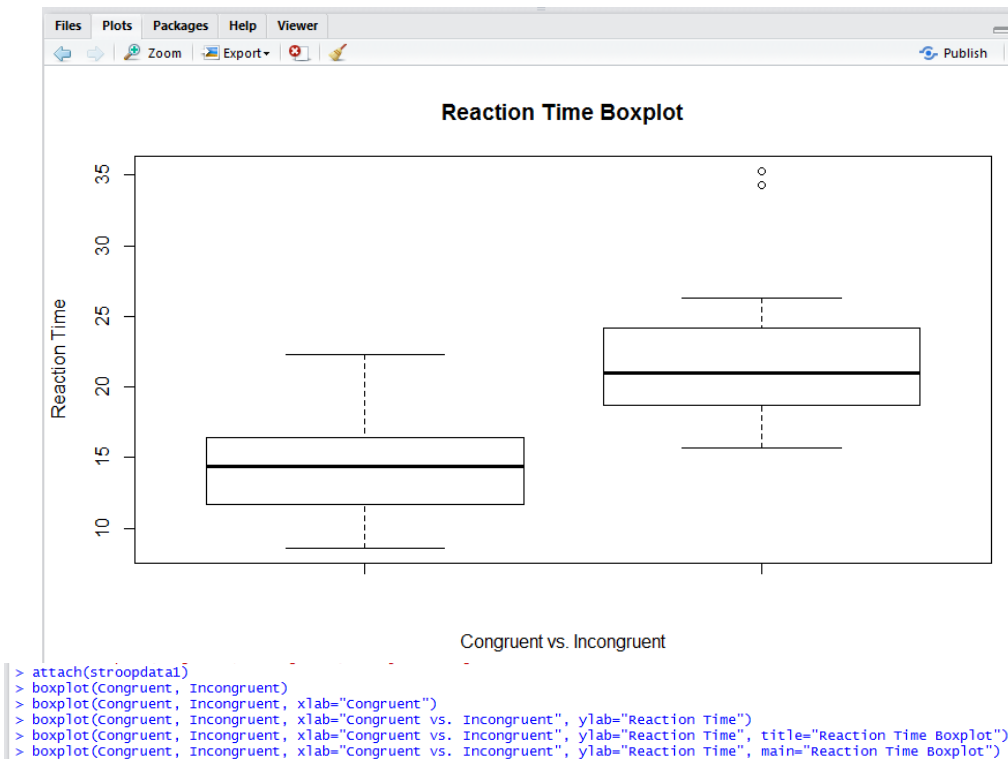
Measure of Variability:
Congruent Range – 13.698 seconds
Incongruent Range – 19.568 seconds
Average Absolute Congruent Deviation: 2.85
Average Absolute Incongruent Deviation: 3.40

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.

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Reaction Time Boxplot

Congruent vs. Incongruent

```
> attach(stroopdata1)
> boxplot(Congruent, Incongruent)
> boxplot(Congruent, Incongruent, xlab="Congruent")
> boxplot(Congruent, Incongruent, xlab="Congruent vs. Incongruent", ylab="Reaction Time")
> boxplot(Congruent, Incongruent, xlab="Congruent vs. Incongruent", ylab="Reaction Time", title="Reaction Time Boxplot")
> boxplot(Congruent, Incongruent, xlab="Congruent vs. Incongruent", ylab="Reaction Time", main="Reaction Time Boxplot")
```

Zoom   Export ▾   Publish

Reaction Time of Participants

Participant

```
> mp <- barplot(height, beside=TRUE, ylim = c(0, 60))
> mp <- barplot(height, beside=TRUE, ylim = c(0, 60), names.arg= stroopdata1$Congruent)
> mp <- barplot(height, beside=TRUE, ylim = c(0, 60), names.arg= stroopdata1$Participant)
> mp <- barplot(height, beside=TRUE, ylim = c(0, 60), names.arg= stroopdata1$Participant, main="Reaction Time of Participants")
```

The boxplot shows a comparison between the congruent and incongruent data and shows the incongruent contains 2 outliers of data around 35 seconds, which would affect the overall mean and median of the incongruent data. The bar plot shows the reaction time comparisons for each participant; all participants in this experiment received a lower time in the congruent condition than 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? Come to a conclusion in terms of the experiment task. Did the results match up with your expectations?

```
> shapiro.test(stroopdata1$Congruent)

        Shapiro-Wilk normality test

data:  stroopdata1$Congruent
W = 0.97092, p-value = 0.6898

> shapiro.test(stroopdata1$Incongruent)

        Shapiro-Wilk normality test

data:  stroopdata1$Incongruent
W = 0.85395, p-value = 0.00259
```

I performed a Shapiro-Wilk Normality Test in R:

The first Shapiro-Wilk Test was performed on the Congruent data. The p-value returned was 0.6898, which is greater than 0.05, which would fail to reject the null hypothesis. The second Shapiro-Wilk Test was performed on the Incongruent data and the p-value returned was 0.00259, which is less than 0.05. The null hypothesis can then be rejected, which means the incongruent data is not normally distributed.

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!

I believe that the congruent/incongruent is responsible for the effects observed, but I also believe that participants have an effect. One participant might be a very visual observer so it would take them longer in the incongruent condition to decipher the correct word that is spelled out. Other participants are able to ignore the font color and correctly identify the word, which would have an effect on the reaction times. There is also a possibility that the gender and age of the participant can also have an effect on the test. I think an alternative or similar task that would lead to this would be to display shape words for the congruent condition, and then change the shape of the word but the participant would still need to correctly say the word of the shape, not the actual shape the word is making. For example, circle could be manipulated to look like a square, but the participant would need to correctly identify the shape word is still a circle.