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Stroop Effect Analysis

In a Stroop test, participants are shown two lists of words in different colors. The first list, called the congruent condition, contains words that match the color they are displayed in. The seconds list, the incongruent condition, contains words that do not match the colors they are displayed in. The task of the participants is to read aloud each word and the time taken to read each list is recorded.

1. Independent and Dependent variables

Our independent variable is the word color congruency condition, since they determine the time taken by a person to complete the task. Our dependent variable is the time taken to read the list of words.

2. Set of Hypotheses

Null Hypothesis: There is no significant difference between the population mean for the times recorded.

Alternative Hypothesis: The difference in means for the two samples is not zero. Implying that, the means are significantly different. The hypotheses would be symbolically formed as:

$H_o: \mu_1 = \mu_2$ For the null hypothesis
$H_2: \mu_1 \neq \mu_2$ For the alternative hypothesis

Where μ_1 represents the population mean of the congruent times, and μ_2 represents the population mean for the incongruent times.

In this form, our alternative hypothesis is that the two means are not equal and are significantly different. Another way to put it, is that the difference in means is not equal to zero. The null hypothesis is that the difference in both means is zero, and are not significantly different.

With a sample size of 24, I expect to perform a two-tailed t-test with 23 degrees of freedom. Since the sample data is recorded from repeated measures, making the two sample data dependent, it will be a paired sample t-test.

Assumptions

Since we are running a two-tailed t-test for dependent means we can make assumptions that can be violated without serious error.

I. The data uses an interval scale of measurement.
II. The samples are drawn randomly from a defined population.
III. The set of data are linked in the population, through repeated measurement. Meaning there are sets of two data for each participant.
IV. The scores attained are normally distributed.

3. Summary Statistics and Measure of Variability

```
Congruent      Incongruent
 Min.   : 8.63   Min.   :15.69
 1st Qu.:11.90   1st Qu.:18.72
 Median :14.36   Median :21.02
```

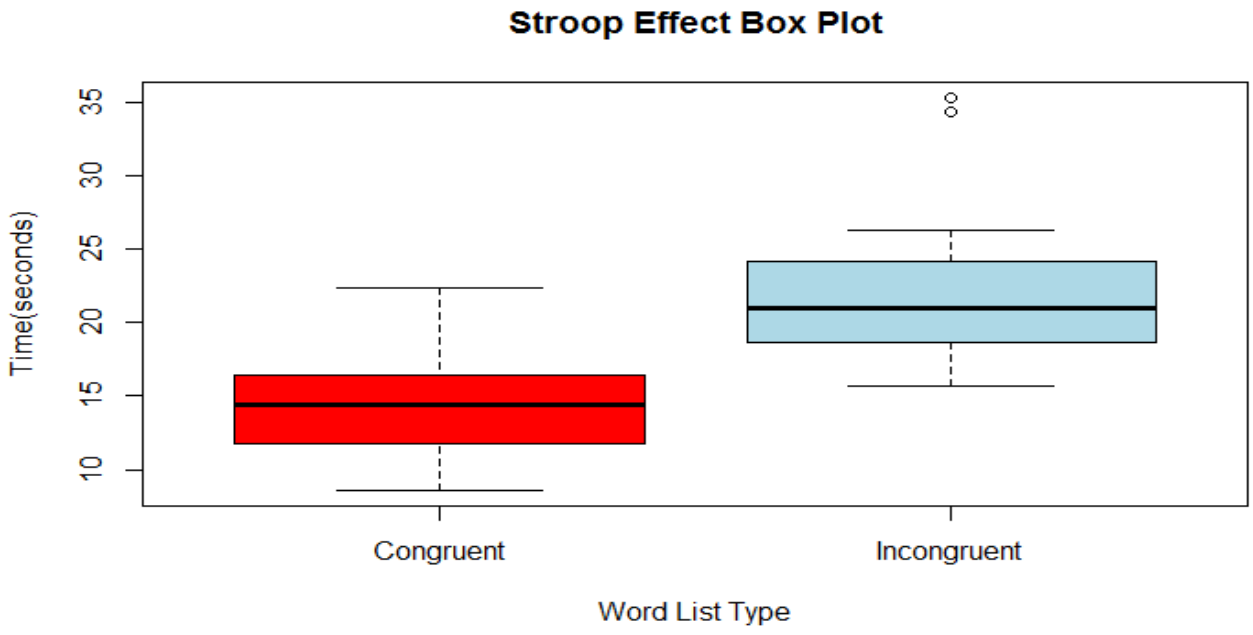
```
 Mean   :14.05   Mean   :22.02
 3rd Qu.:16.20   3rd Qu.:24.05
 Max.   :22.33   Max.   :35.26
```

Measure of variability

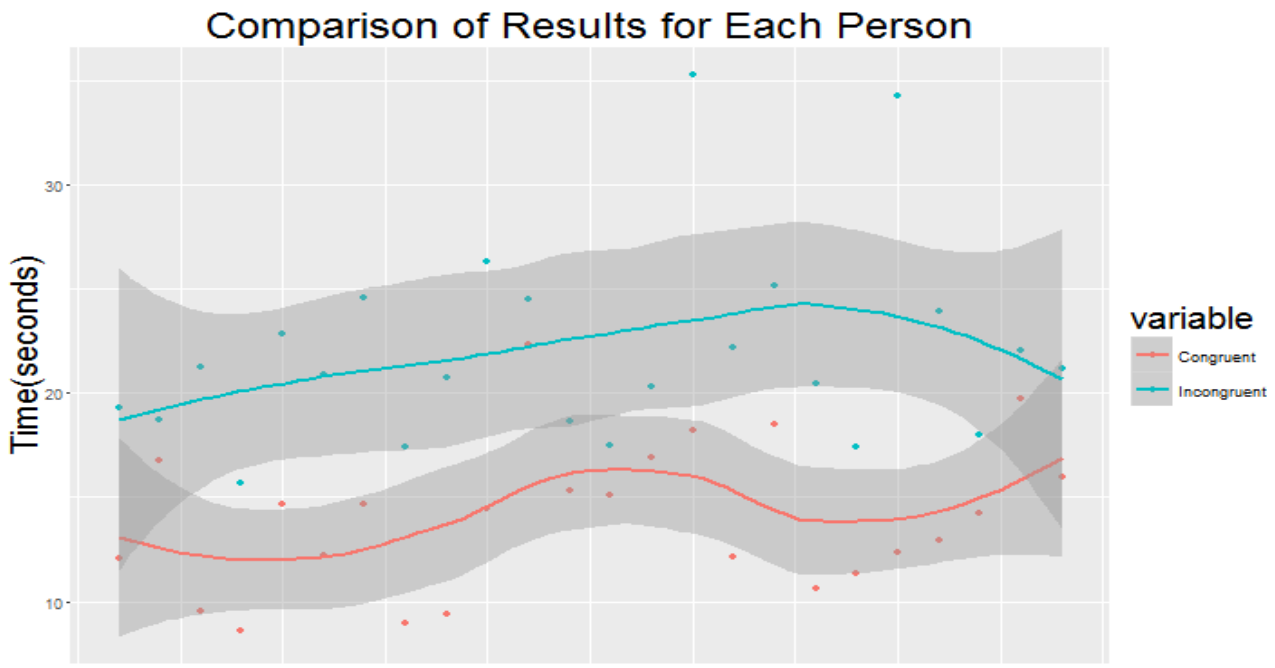
```
Variance and Standard deviation for congruent: 12.66903, 3.559358
Variance and Standard deviation for incongruent: 23.01176, 4.797057
```

Looking at the descriptive statistics, we see that the minimum value for the Incongruent task is greater than the mean time for the Congruent task. There is a clear trend for higher times for the Incongruent condition, although there is higher variability.

4. Data Visualization



The box plot of the data gives us a view of the median, 1st and 3rd quartiles and the outliers for the two sample data. It is easy to see the differences in time trends between the two samples.



This scatter plot compares the time taken to complete the task for both congruent and incongruent words. The points on the same y-axis represent the recorded time by one person. We can see that, times for the congruent task tend to be completed faster than the incongruent task, as they are lower on the graph.

5. Statistical test and Results

In order to see whether or not there is a true difference in means, a two-tailed paired sample t-test was performed. At 95% confidence level our t-critical value was -2.069.
t(23)= -2.069, p = `4.103e-08, two-tailed.`

The t-statistic was, -8.034 which falls in the critical region below -2.069, this also tells us that the difference in means is not zero, and that the means for the congruent times are smaller than the times for the incongruent test. Our exact p-value was, `4.103e-08,` which is smaller than our level of significance of .05. With this result we may reject our null hypothesis that there is no true difference between the means.

These results match up with the expectation that, it takes longer to read a list of words that are not congruent in color and meaning compared to words that are.

6. Conclusions and Ideas

Having taken the test myself, I found myself putting more effort to not read the incorrect word. This might be because I am recognizing the word before the color. When reading the incongruent words, the person has to stop themselves from saying the word before interpreting the correct color. I am more inclined to agree with the theory that most people have had a long-term habit of reading, and that the brain has made the reading process almost automatic that it takes an extra amount of focus to ignore the word in order to say the correct color.

The brain is able to fill in the gaps, and even ignore subtle spelling mistakes in favor of understanding the content of the words. A similar task that would produce similar results would be a task that has the person taking the test to perform a task in the reverse order. An example would be to record the time it

takes for a person to, recite the alphabet backwards, count backwards, perform math operations backwards. Since most of us are so used to performing tasks in a certain order, it will take more time to perform these tasks for most people.

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