Hide Code

DAND Stroop Project

The Stroop Effect was developed by John Ridley Stroop. In the Stroop study, subjects are shown a list of words, each in a different color of ink. This study is measured in two ways. In the first measurement(condition), the subjects are first given a list where the color of the word matches the word. The second measurement(condition) differs in that the color of ink and the word do not match.

The independent variable in the study is the color/word association. The dependent variable is time in seconds it takes the subject to speak the word.

The hypothesis for this test is expressed as thus:

$\boldsymbol{H_0}$ **:** $\mu_c = \mu_i$
$\boldsymbol{H_A}$ **:** $\mu_c > \mu_i$

$\mu_c =$ word congruency

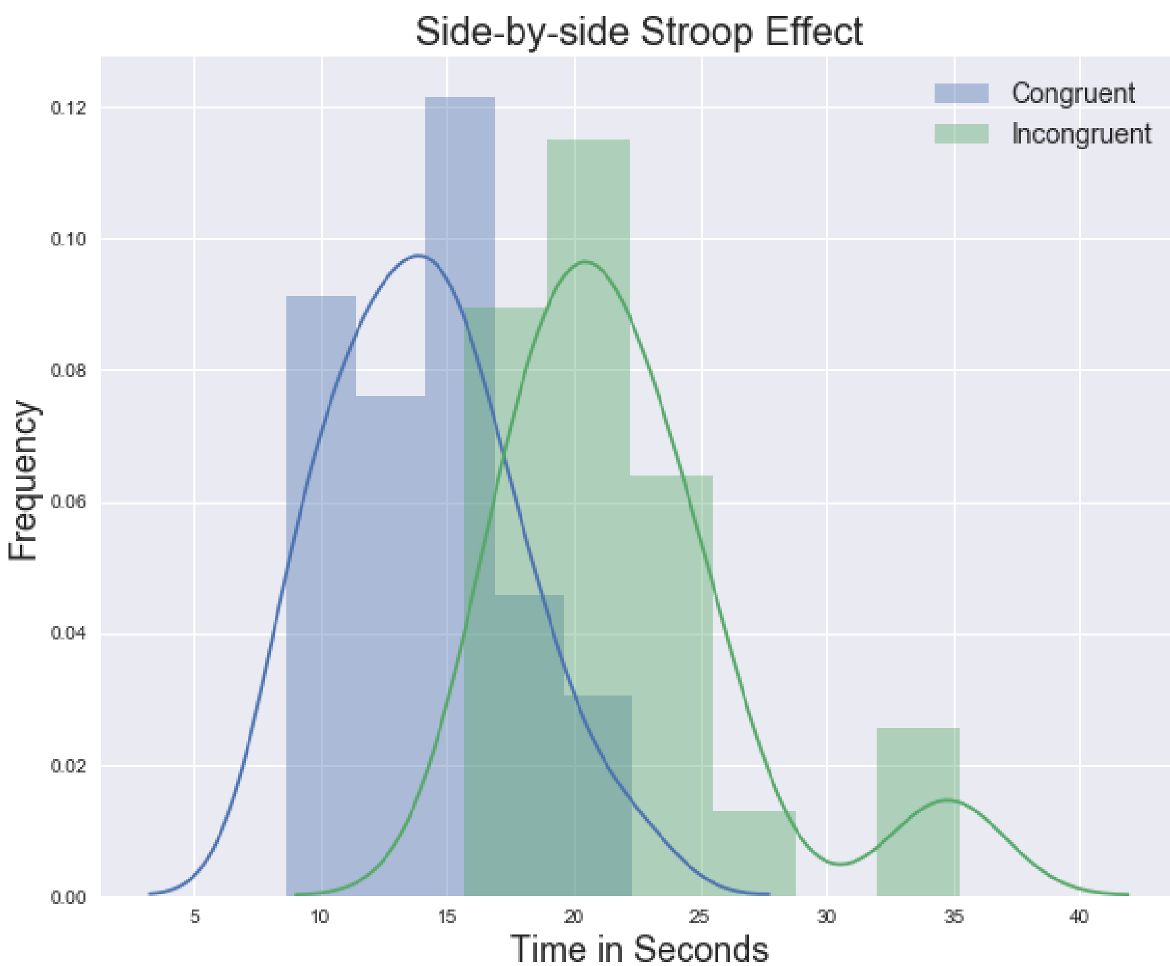
$\mu_i =$ word incongruency

The null hypothesis states that the congruent times and the incongruent times will remain the same for the Stroop test. The alternative hypothesis states that the times for the incongruent test will be greater than the congruent times. We use a t-test because our population Standard Deviation is not known, and our sample size is less than 30.

In [72]:
```
%matplotlib inline
import numpy as np
import pandas as pd
import matplotlib.mlab as mlab
import matplotlib.pyplot as plt
import seaborn as sn
```

In [73]:
```
stroop = pd.read_csv('./stroopdata.csv')
```

In [99]:
```
sc = stroop['Congruent']
si = stroop['Incongruent']
plt.subplots(figsize=(10,8))
sn.distplot(sc);
sn.distplot(si);
plt.title('Side-by-side Stroop Effect',fontsize=20)
plt.legend(['Congruent', 'Incongruent'],fontsize=14);
plt.xlabel('Time in Seconds',fontsize=18)
plt.ylabel('Frequency',fontsize=18)
plt.show()
```



In [75]:
```
print(stroop.describe())
```

```
       Congruent  Incongruent
count  24.000000    24.000000
mean   14.051125    22.015917
std     3.559358     4.797057
min     8.630000    15.687000
25%    11.895250    18.716750
50%    14.356500    21.017500
75%    16.200750    24.051500
max    22.328000    35.255000
```

In the histograms above, we can clearly see a shift in the time taken between the congruent list and the incongruent list. The subjects average time(mean) to speak the word is 14.05 seconds for the congruent list. While the average time(mean) to speak the incongruent word is 22.02 seconds. The apex of each histogram shows the middle(median) response times to be 14.36 for congruent and 21.02 for incongruent. The mode, or most common value, is a bit trickier to determine. Because the test calculates the results down to the thousandth of a second, each value is unique and therefore each is the mode. If we reduce the data to whole numbers we see that the mode for congruent returns a range of values (12, 15). The results for incongruent values show 21 as the most common.

In [125]:
```
scround = sc.round(0)
siround = si.round(0)
print('Median\nCongruent',sc.median(),'\nIncongruent',si.median(),'\n')
print('Mode\nCongruent\n',scround.mode(),'\n\nIncongruent\n',siround.mode())
```

```
Median
Congruent 14.3565
Incongruent 21.0175

Mode
Congruent
 0    12.0
1    15.0
dtype: float64

Incongruent
 0    21.0
dtype: float64
```

In [77]:
```
print('Unrounded Mode Results\n\n',stroop.mode())
```

```
Unrounded Mode Results

     Congruent  Incongruent
0        8.630       15.687
1        8.987       17.394
2        9.401       17.425
3        9.564       17.510
4       10.639       17.960
5       11.344       18.644
6       12.079       18.741
7       12.130       19.278
8       12.238       20.330
9       12.369       20.429
10      12.944       20.762
11      14.233       20.878
12      14.480       21.157
13      14.669       21.214
14      14.692       22.058
15      15.073       22.158
16      15.298       22.803
17      16.004       23.894
18      16.791       24.524
19      16.929       24.572
20      18.200       25.139
21      18.495       26.282
22      19.710       34.288
23      22.328       35.255
```

In support of the alternative hypothesis, this test will be a one-tailed dependent t-test. It is a dependent test because both samples use the same population and each result is directly related to the other.

Results

t(23) = 8.04, p < .01, one-tailed. At $\alpha = .05$ and a Confidence Interval on the mean difference(7.97); 95% CI = (5.92, 10.01).

This shows that the results are statistically significant. r2 shows a very strong correlation at 74%.

n = 24
df = 23
SD = 4.85
Mean difference = 7.97
Standard Error of Differences = 0.99
t-statistic = 8.04
T-critical = 2.069
Cohen's d = 1.89
r2 = .74

Hypothesis Results and Conclusions

The resultant data clearly shows that once the treatment effect was applied, the subject's reaction time significantly increased. Therefore, I reject the null hypothesis in favor of the alternative hypothesis. The results were not at all unexpected. When we challenge our brains to process information in new ways there is a significant learning curve to overcome to become proficient. The Stroop Effect represents that process.

Sources

Stroop Effect (https://en.wikipedia.org/wiki/Stroop_effect)

Testing a Hypothesis for Dependent and Independent Samples (https://www.ck12.org/book/CK-12-Probability-and-Statistics-Advanced-Second-Edition/section/8.5/)

Code Visibility (http://chris-said.io/2016/02/13/how-to-make-polished-jupyter-presentations-with-optional-code-visibility/)