Test a Perceptual Phenomenon

February 15, 2018

0.0.1 Analyzing the Stroop Effect

Perform the analysis in the space below. Remember to follow the instructions and review the project rubric before submitting. Once you've completed the analysis and write up, download this file as a PDF or HTML file and submit in the next section.

(1) What is the independent variable? What is the dependent variable?

Independent variable: Word Condition (Congruent or Incongruent). **Dependent variable:** Response Time (seconds)

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

H0 - Null Hypothesis: (i - c = 0) There is no significant difference in the population average response times in viewing the congruent words vs viewing the incongruent words.
H1 - Alternative Hypothesis: (i - c 0) There is a significant difference in the population average response times in viewing the congruent words vs viewing the incongruent words.

I'm going to use **Paired two-sample t-tests** because typically it consists of a sample of matched pairs of similar units, or one group of units that has been tested twice.

(3) Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability. The name of the data file is 'stroop-data.csv'.

```
In [1]: # Read data
        import pandas as pd
        df = pd.read_csv('stroopdata.csv')
        df
```

Out[1]:

	Congruent	Incongruent
0	12.079	19.278
1	16.791	18.741
2	9.564	21.214
3	8.630	15.687
4	14.669	22.803
5	12.238	20.878
6	14.692	24.572

```
7       8.987       17.394
8       9.401       20.762
9      14.480       26.282
10     22.328       24.524
11     15.298       18.644
12     15.073       17.510
13     16.929       20.330
14     18.200       35.255
15     12.130       22.158
16     18.495       25.139
17     10.639       20.429
18     11.344       17.425
19     12.369       34.288
20     12.944       23.894
21     14.233       17.960
22     19.710       22.058
23     16.004       21.157
```

In [2]:
```
c = df['Congruent'];i = df['Incongruent']
#mean time for congurent and for incongurent/ measures of central tendency
c_mean =c.mean()
i_mean = i.mean()
c_mean,i_mean
```

Out[2]:
```
(14.051124999999999, 22.015916666666666)
```

In [37]:
```
#mean difference
mean_diff = i_mean-c_mean
mean_diff
```

Out[37]:
```
7.9647916666666667
```

In [4]:
```
#standart deviation/ measure of variability
c_std = c.std()
i_std = i.std()
c_std,i_std
```

Out[4]:
```
(3.5593579576451955, 4.7970571224691376)
```

In [5]:
```
#difference in standart deviations
i_std-c_std
```

Out[5]:
```
1.2376991648239422
```

In [36]:
```
#standard deviation of the difference
df['Difference'] = df['Congruent'] - df['Incongruent']
std_diff = df['Difference'].std(axis=0)
std_diff
```

Out[36]:
```
4.8648269103590556
```

Descriptive statistics for our data:

/ measures of central tendency:

Mean responce time for congurent words is 14.05 sec and for incongurent words is 22.02 sec. Mean difference is 7.96

/ measures of variability:

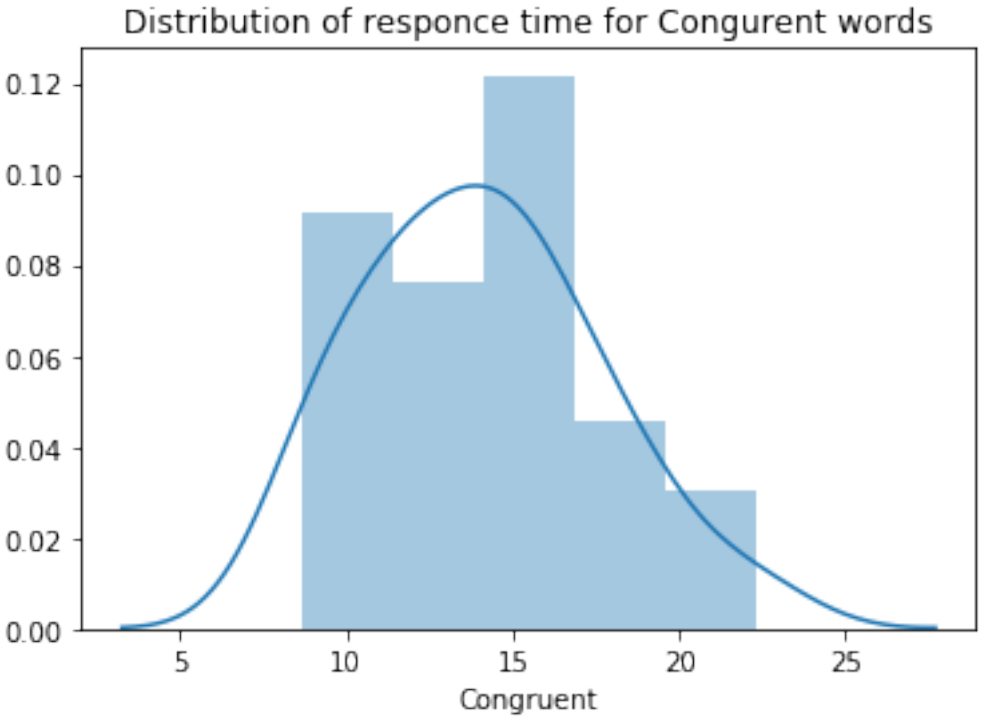
Standart deviation for congurent words is 3.56 and for incongurent words is 4.80. Difference in standart deviations is 1.24

Standard deviation of the difference is 4.86.

(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.

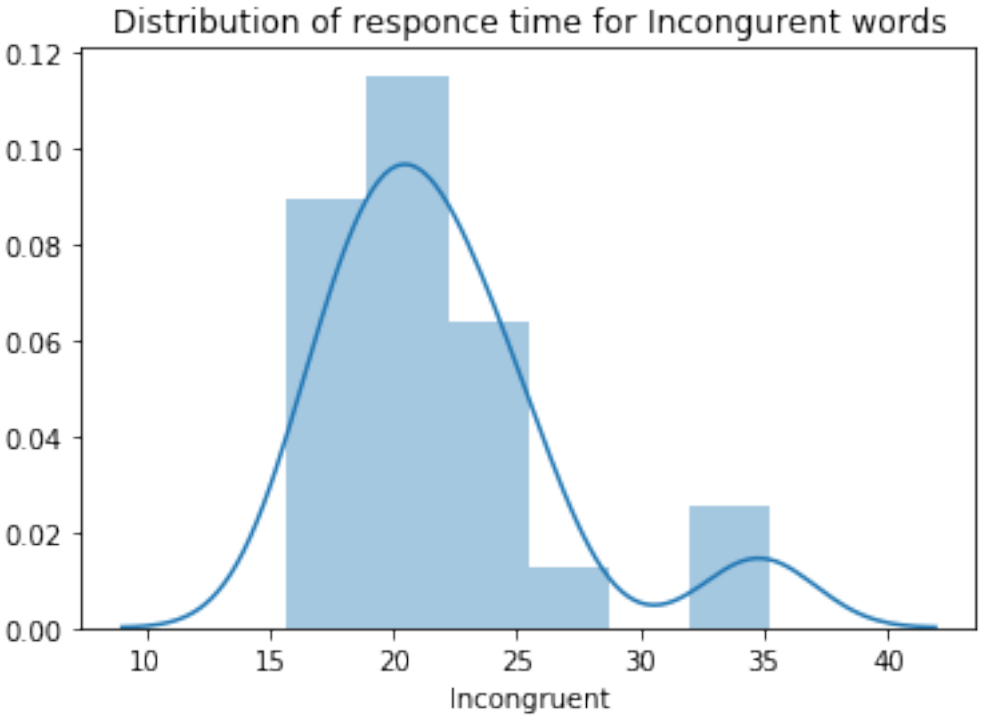
```
In [39]: # Build the visualizations
         import numpy as np
         import matplotlib.pyplot as plt
         %matplotlib inline
         import seaborn as sb
         from scipy.stats import t
         import math

         congurent = sb.distplot(df['Congruent'])
         congurent.set_title('Distribution of responce time for Congurent words')
```

```
Out[39]: Text(0.5,1,'Distribution of responce time for Congurent words')
```



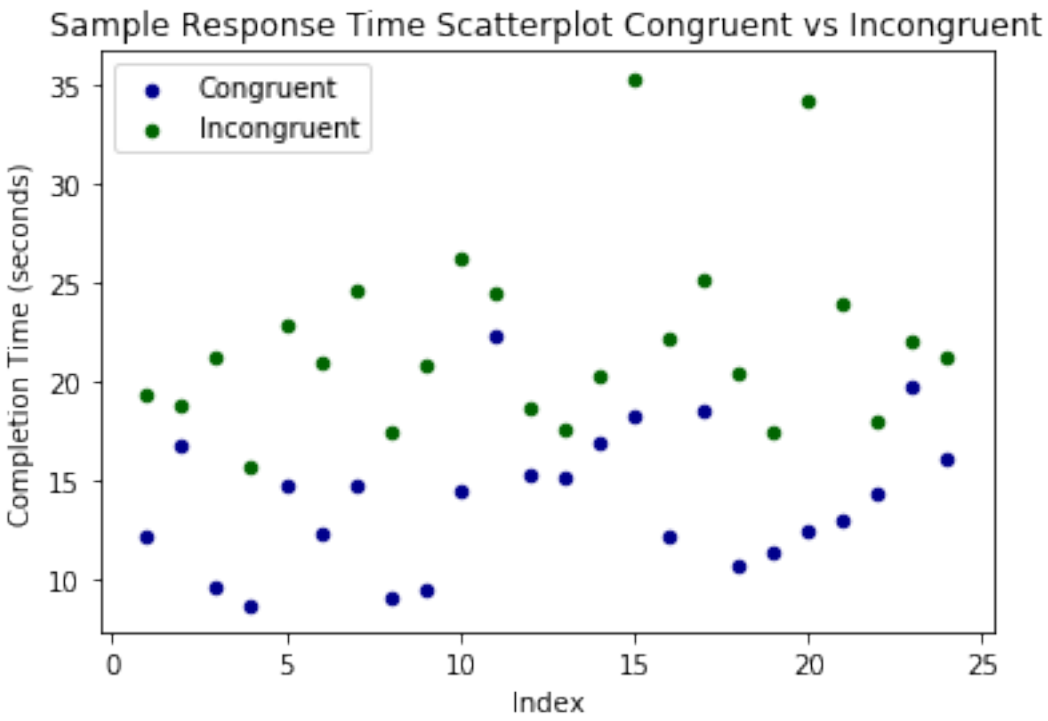
In [27]:
```
incongurent = sb.distplot(df['Incongruent'])
incongurent.set_title('Distribution of responce time for Incongurent words')
```

Out[27]:
```
Text(0.5,1,'Distribution of responce time for Incongurent words')
```

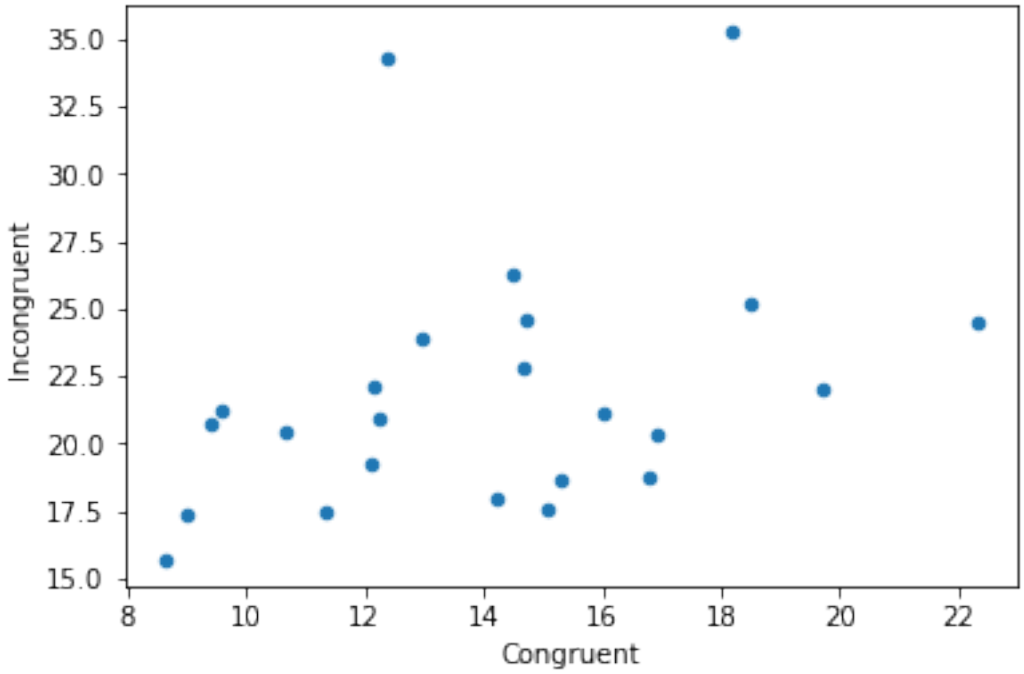


In [28]:
```
df['index'] = df.index+1
ax = df.plot.scatter(x='index', y='Congruent', color='DarkBlue', label='Congruent');
df.plot.scatter(x='index', y='Incongruent', color='DarkGreen', label='Incongruent', ax=
ax.set_title('Sample Response Time Scatterplot Congruent vs Incongruent')
ax.set_xlabel('Index')
ax.set_ylabel('Completion Time (seconds)')
```

Out[28]:
```
Text(0,0.5,'Completion Time (seconds)')
```




```
In [29]: df.plot.scatter(x='Congruent', y='Incongruent');
```



For congurent words responce time distribution looks as normal distribution. For incogurent words distribution also looks like normal but has outlier data that skewed it right. Mean is pretty close to the peak in both distributions which confirms a normal distribution. We can see that time for incogurent data is larger than for incogurent. Scatter plots shows some degree of correlation between two data sets. The congruent words sample has a lower average completion time compared to the incongruent words scatterplot.

(5) Now, perform the statistical test and report the results. What is the 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?

```
In [44]: # Perform the statistical test here
         # Sample size
         len(df)

Out[44]: 24

In [43]: #t-critical value for a 95% confidence level and degree of freedom = 23 (number of data
         t.ppf(.95, 23)

Out[43]: 1.7138715277470473

In [40]: #t-statistic
         mean_diff/(std_diff / math.sqrt(24))

Out[40]: 8.020706944109957
```

Our t-statistic 8.02 is greater than our critical value 1.71, so we can reject the null hypothesis. There is significant difference in the population average response times in viewing the congruent words vs viewing the incongruent words. Which is pretty obvious from my own experiment.

Resources: 1. http://luizschiller.com/stroop-effect/ 2. https://en.wikipedia.org/wiki/Student%27s_t-test 3. https://seaborn.pydata.org/generated/seaborn.distplot.html 4. https://pandas.pydata.org/pandas-docs/stable/visualization.html#visualization-scatter