Test a Perceptual Phenomenon

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0.1 Analyzing the Stroop Effect

0.1.1 What is the Stroop Effect?

The Stroop effect refers to the delayed reaction times when the color of the word doesn't match the name of the word. It's easier to say the color of a word if it matches the semantic meaning of the word. For example, if someone asked you to say the color of the word "black" that was also printed in black ink, it would be much easier to say the correct color than if it were printed in green ink.[1]

0.1.2 Objective of this analysis

In this analysis, we shall test whether incongruent tasks take longer than congruent tasks or if there are no differences between the two.

Incongruent task - Identifying color of the word when the color and word are not simlar ie, incongruent.

Congruent task - Identifying color of the word when the color and word are simlar ie, congruent.

0.1.3 Declaration of independent and dependent variable

The independent variables are congruent and incongruent.

The dependent variable is the time required to complete the test.

0.1.4 Null and Alternate Hypothesis

Null Hypothesis (H0): no difference in time between two tasks,

Alternative Hypothesis (H1): incongruent task takes longer than congruent task.

H_0: μi = μc

H_1: μi > μc

μi - population mean of incongruent values

μc - population mean of congruent values

0.1.5 Some descriptive analysis of the data

```
In [1]: import pandas as pd
        import matplotlib as plt
        import numpy as np
        import seaborn as sns
```

```
from scipy.stats import t
import math

%matplotlib inline
```

In [2]:
```
df = pd.read_csv('stroopdata.csv')
df.head()
```

Out[2]:

	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

In [3]:
```
df.describe()
```

Out[3]:

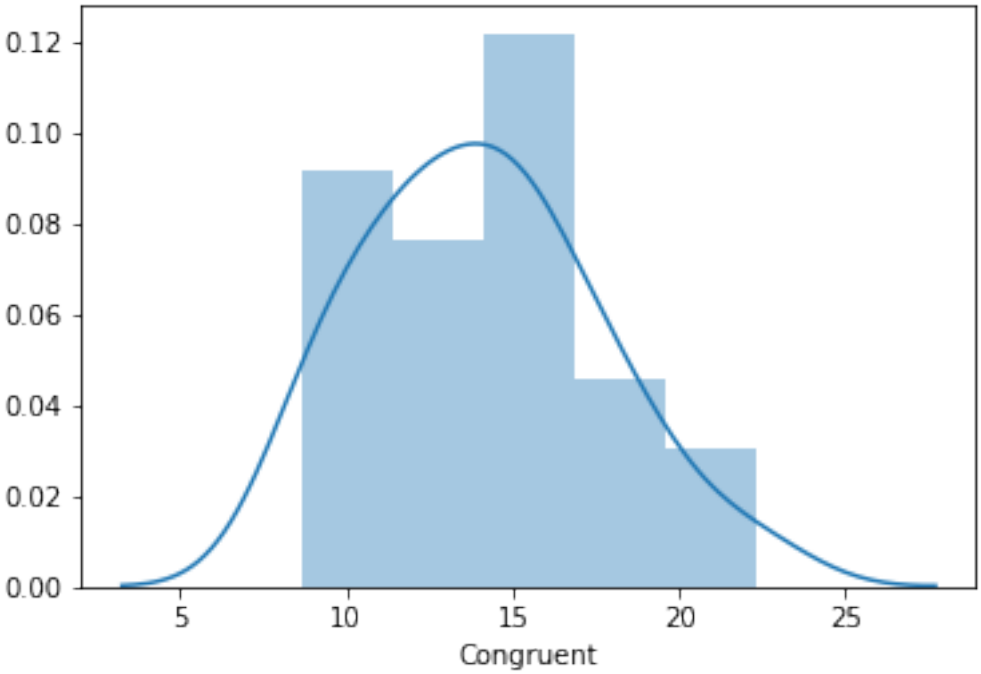
	Congruent	Incongruent
count	24.000000	24.000000
mean	14.051125	22.015917
std	3.559358	4.797057
min	8.630000	15.687000
25%	11.895250	18.716750
50%	14.356500	21.017500
75%	16.200750	24.051500
max	22.328000	35.255000

The congruent values range from 8.6 to 22.3 and as for the incongruent values, 15.6 to 35.2

0.1.6 Visualisations of the distribution of data

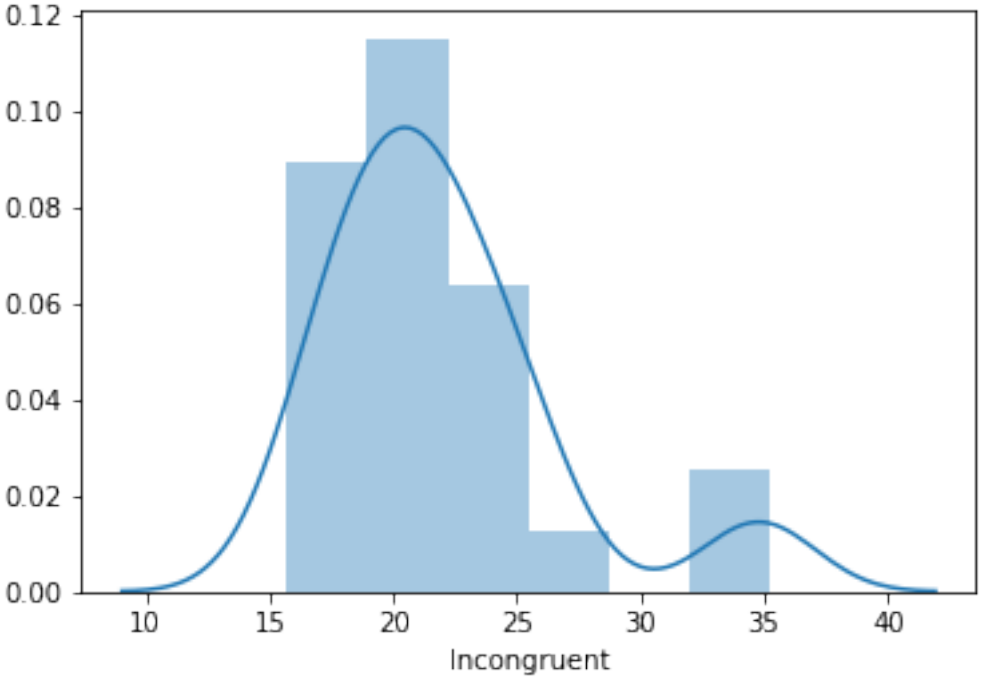
In [4]:
```
# Build the visualizations here
sns.distplot(df['Congruent'])
```

Out[4]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f7dd8682cf8>
```



In [5]: sns.distplot(df['Incongruent'])

Out[5]: <matplotlib.axes._subplots.AxesSubplot at 0x7f7dd660cda0>



Both the plots more or less show that the data is normally distributed.

0.1.7 Statistical test to test our hypothesis

To condct the statistical test, we will be using the t-statistic as the size of the sample is less than 30 as opposed to z-test which is best suited for a larger sample size ie, greater than 30 units.

```
In [6]: # finding out the sample size
        len(df)
```

```
Out[6]: 24
```

The sample size is 24. The degree of freedom (df) is 1 less than the sample size so,
df: 24-1 = 23
Confidence level: 95%

```
In [7]: # Calculating the t-critical value
        t.ppf(.95, 23)
```

```
Out[7]: 1.7138715277470473
```

The t-critical value is 1.713
To conduct the t-test, we will need the difference of means of congruent and incongruent values (point estimate/PE) and the standard deviation of the differences.

```
In [8]: # Calculating the point_estimate
        point_estimate = df['Incongruent'].mean() - df['Congruent'].mean()
        print('The PE is {0:.4f}'.format(point_estimate))
```

```
The PE is 7.9648
```

```
In [9]: # Calculating the standard deviation of the differences
        df['Difference'] = df['Congruent'] - df['Incongruent']
        SD_Diff = df['Difference'].std(axis = 0)
        print("The standard deviation for congruent {0:.4f}".format(SD_Diff))
```

```
The standard deviation for congruent 4.8648
```

```
In [10]: # Calculating the T-statistic
         t_stat = point_estimate/(SD_Diff/(math.sqrt(24)))
         print("The t-statistic is", t_stat)
```

```
The t-statistic is 8.02070694411
```

0.1.8 Conclusion

T-statistic, 8.0207 is greater than the t-critical value, 1.713, thus we can reject the null hypothesis.

This implies that the congruent task takes less time to do than the incongruent task, which was expected. It takes lesser time to identify the color of a word if the color and the word are same than it does if they are different.

0.1.9 References

[1] What is the stroop effect? - https://www.verywellmind.com/what-is-the-stroop-effect-2795832

Diffrence between t-test and z-test - https://keydifferences.com/difference-between-t-test-and-z-test.html

T-statistic explained - https://www.statisticshowto.datasciencecentral.com/t-statistic/

Stroop test explained - https://www.youtube.com/watch?v=EGpzftQf8oI