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, upload that PDF/HTML into the workspace here (click on the orange Jupyter icon in the upper left then Upload), then use the Submit Project button at the bottom of this page. This will create a zip file containing both this .ipynb doc and the PDF/HTML doc that will be submitted for your project.

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

Independent variable is: The word/colour congruency is the varable being manipulated in the experiment

Dependent variable is: The time it takes to recognize/name the ink colors of the mismatch word/colour congruency

(2) What is an appropriate set of hypotheses for this task? Specify your null and alternative hypotheses, and clearly define any notation used. Justify your choices.

Null Hypothsis, H0 - The mismatch of color to word will have no effect or decrease time to recognize and say the color

Alternate Hypothesis, H1 - The mismatch of color to word will increase time to recognize and say the color

H0: μi ≤ μc (μi - population mean of incongruent values, μc - population mean of congruent values)

H1: μi > μc (μi - population mean of incongruent values, μc - population mean of congruent values)

statistical test choices and assumptions

- 95% confidence interval
- Paired one tail t-test -> with two tests per participant this test show if the mean of incongruent words is statistically significantly different from the congruent words at an alpha of 0.05.

assumptions/why: I will be using a t-test instead of a z-test because 1) the population standard deviation is unknown and 2) the sample set is less than 30. The t-test will be a one tailed t-test i.e. my directional alternative hypothesis is that participant's incongruent sample mean will be larger than the participant's congruent sample mean

A paired t-test (or dependent sample test), will be used because the data set is of one group of participants tested twice under different conditions (word/colour congruency). This will also facilitate either rejecting or accepting the null hypothesis.

(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 'stroopdata.csv'.

In [2]:
```
**sample size** = 24

**mean:** $\bar{x} = \Sigma(x)/n$ (where xbar is the sample mean, x is the value and n is the number of samples)

Congruent: 14.05, Incogruent: 22.02

**median:** as the data seems slightly positively skewed, median is a better representation of central tendency

Congruent: 14.3565, Incongruent: 21.0175

**sample std. deviation:** $\sigma = \Sigma((x - xbar)^2)/n$

Congruent: 3.56, Incongruent: 4.80

        # Render our plots inline
%matplotlib inline

import matplotlib.pyplot as plt
import pandas as pd
import numpy as np

stroop = pd.read_csv("stroopdata.csv")
```

In [7]:
```
# dataset
print(stroop)
```

```
    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]:
```
# descriptive stats
stroop.describe()
```

In [58]:

Out[58]:

	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 [2]:
```
# median / 50% values
congruent = stroop['Congruent']
incongruent = stroop['Incongruent']
congruent.median(), incongruent.median()
```

```
  File "<ipython-input-2-e03429f864d4>", line 1
    **sample size** = 24
     ^
SyntaxError: invalid syntax
```

(14.3565, 21.0175)

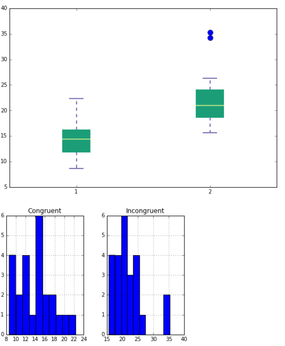
(4) Provide one or two visualizations that show the distribution of the sample data. Write one or two sentences noting what you observe about the plot or plots.

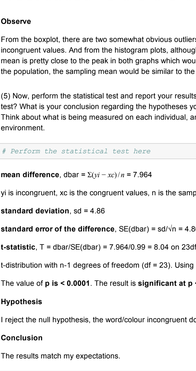
In [3]:
```
data = np.genfromtxt('stroopdata.csv', delimiter=',',dtype=np.float32)
plt.figure(1, figsize=(9, 6))

plot1 = plt.boxplot(data,vert=True,widths = 0.2,patch_artist=True)

plt.setp(plot1['boxes'], color='#1b9e77', linewidth=2, facecolor='#1b9e77')
plt.setp(plot1['whiskers'], color='#757Ub3', linewidth=2)
plt.setp(plot1['caps'], color='#757Ub3', linewidth=2)
plt.setp(plot1['fliers'], color='#e7298a', marker='o', markersize=10)
plt.setp(plot1['medians'], color='#b2df8a', linewidth=2)

# histogram
stroop.hist()
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-3-d9f17268eebe> in <module>()
----> 1 data = np.genfromtxt('stroopdata.csv', delimiter=',',dtype=np.float32)
      2 plt.figure(1, figsize=(9, 6))
      3
      4 plot1 = plt.boxplot(data,vert=True,widths = 0.2,patch_artist=True)
      5

NameError: name 'np' is not defined
```

In [59]:

Out[59]:
```
array([[<matplotlib.axes._subplots.AxesSubplot object at 0x11e7c3b50>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x11e684b10>]], dtype=object)
```





Observe

From the boxplot, there are two somewhat obvious outliers or extraneous data which would possible skew the true mean of incongruent values. And from the histogram plots, although both graphs visually appear somewhat positively skewed, the mean is pretty close to the peak in both graphs which would indicate a normal distribution. Provided these are samples from the population, the sampling mean would be similar to the population mean.

(5) Now, perform the statistical test and report your results. What is your confidence level or Type I error associated with your test? What is your conclusion regarding the hypotheses you set up? Did the results match up with your expectations? **Hint:** Think about what is being measured on each individual, and what statistic best captures how an individual reacts in each environment.

In [1]:
```
# Perform the statistical test here
```

mean difference, dbar = $\Sigma(yi - xc)/n$ = 7.964

yi is incongruent, xc is the congruent values, n is the sample set

standard deviation, sd = 4.86

standard error of the difference, SE(dbar) = sd/√n = 4.86/√24 = 0.99

t-statistic, T = dbar/SE(dbar) = 7.964/0.99 = 8.04 on 23df

t-distribution with n-1 degrees of freedom (df = 23). Using the t-distribution table to find p-value...

The value of **p is < 0.0001**. The result is **significant at p < 0.05%**

Hypothesis

I reject the null hypothesis, the word/colour incongruent does cause a greater time response

Conclusion

The results match my expectations.

In [ ]:
```
stroop = pd.read_csv("stroopdata_updated.csv")
print(stroop)
```

In [5]:

```
    Congruent  InCongruent  Difference  Mean Difference  Std Deviation
0      12.079       19.278       7.199         7.964792      4.864827
1      16.791       18.741       1.950              NaN           NaN
2       9.564       21.214      11.650              NaN           NaN
3       8.630       15.687       7.057              NaN           NaN
4      14.669       22.803       8.134              NaN           NaN
5      12.238       20.878       8.640              NaN           NaN
6      14.692       24.572       9.880              NaN           NaN
7       8.987       17.394       8.407              NaN           NaN
8       9.401       20.762      11.361              NaN           NaN
9      14.480       26.282      11.802              NaN           NaN
10     22.328       24.524       2.196              NaN           NaN
11     15.298       18.644       3.346              NaN           NaN
12     15.073       17.510       2.437              NaN           NaN
13     16.929       20.330       3.401              NaN           NaN
14     18.200       35.255      17.055              NaN           NaN
15     12.130       22.158      10.028              NaN           NaN
16     18.495       25.139       6.644              NaN           NaN
17     10.639       20.429       9.790              NaN           NaN
18     11.344       17.425       6.081              NaN           NaN
19     12.369       34.288      21.919              NaN           NaN
20     12.944       23.894      10.950              NaN           NaN
21     14.233       17.960       3.727              NaN           NaN
22     19.710       22.058       2.348              NaN           NaN
23     16.004       21.157       5.153              NaN           NaN
```