**Q. 1**

*Independent Variable*: Type of word: Congruent, Incongruent words

*Dependent Variable*: Time it takes to name the ink colors (on th congruent and the incongruent tasks).

**Q. 2**

*u(congruent) = Mean of the time taken for speaking Congruent words,*

*u(Incongruent) = Mean of the time taken for speaking Incongruent words*

*Set of Hypothesis*:

**H0** (Null hypothesis):

- u(congruent) - u(incongruent) = 0
- There is no difference in the time taken to name the color of the ink (in which the word is printed, congruent and Incongruent words)

**Ha** (Alternate Hypothesis):

- u(congruent) - u(incongruent) != 0
- The time taken to name the ink colors of congruent words differ from that of the Incongruent words.

*Kind of statistical test*: -

**Two tail t-test**

```
1. Because we do not know the population standard deviation that's why we use t-tes
t. So, we will use the sample standard deviation.
2. I chose two-tailed test because I do not know (or am not sure) that whether it w
ill take more time to speak incongruent words or not, for every participant. So, we
 can only guess that maybe both the times will differ as per our Alternat Hypothesi
s.
```

- Assumption made by the t-test:
  - Population from which the sample is from is Normal.
  - Congruent and Incongruent Samples should be random samples from a population.

**Q. 3**

**Measure of central tendency**:

```
Mean (X) = X (congruent) - X (incongruent) = -7.964791667
or
Mean (X) = Sum(Ai - Bi)/N = -7.964791667

where X(congruent) = 14.051125 = Mean of Congruent time data
      X(incongruent) = 22.01591667 = Mean of Incongruent time data
      Ai = i(th) term in the congruent data set
      Bi = i(th) term in the congruent data set
      N = Total number of participants = 24
      df = degree of freedom = N-1 = 23
```

**Measure of variability**:

```
Standard deviation(SD) = sqrt((Sum of squared deviations) / (N-1)) = sqrt(2066.8401
91 / 23)
                       = 9.479589495
Variance = Sum of Squared Deviations / (N - 1)
         = 2066.840191 / 23
         = 89.862617

(and accordingly SE (Standard Error) = SD/sqrt(N) = 1.935013103)
```

**Q. 4**

plots (distribution of the sample data)

--> CODE AT LAST

**Q. 5**

Statistical test:

```
- Xc = Mean of the Congruent time, Xi = Mean of the Incongruent time
- u(c) = Population mean of the congruent time, u(i) = Population mean of the Incon
gruent time

- Point Estimate = Xc - Xi = -7.964791667

- t-statistic = (X - u) / SE, X = Xc - Xi and u = u(c) - u(i) = 0 (Null hypothesis)
              = (Xc - Xi) / SE
              = (-7.964791667) / SE
              = -7.964791667 / 1.935013103
              = -4.116143531
```

**Confidence level**: 95% confidence interval

- with 2.5% on the left and 2.5% on the right of the distribution, we are left with 95% in the middle.
- So, CI = 95%, with (-2.069 and +2.069) t-statistics.

*Alpha-level: 0.05 df = N-1 = 23*

**Critical Statistic value**: -2.069, +2.069

**Accept/Reject the null hypothesis**:

- Since our t-statistic value, -4.116143531, falls in the critical region. So, we will **reject** the Null-Hypothesis (H0).
- reason: -4.116143531 (t-statistic) < -2.069 (t-critical Statistic) So, it falls in the critical region.
- Hence, we accept the Alternate Hypothesis (Ha). As, we can clearly see that the time taken to name the Congruent words is lot less than naming the Incongruent words.

Thus, there is **significant difference** between the time taken to speak congruent and incongruent ink words. We can also say that the type of words (congruent/incongruent) had the causal effects on the speaking time of the participants.

**Did the results match up with my expectation?**

- Yes, as I expected that due to the extra thinking time, to identify the ink color of the incongruent words, there will be some difference between both the time results measured.

**Q. 6**

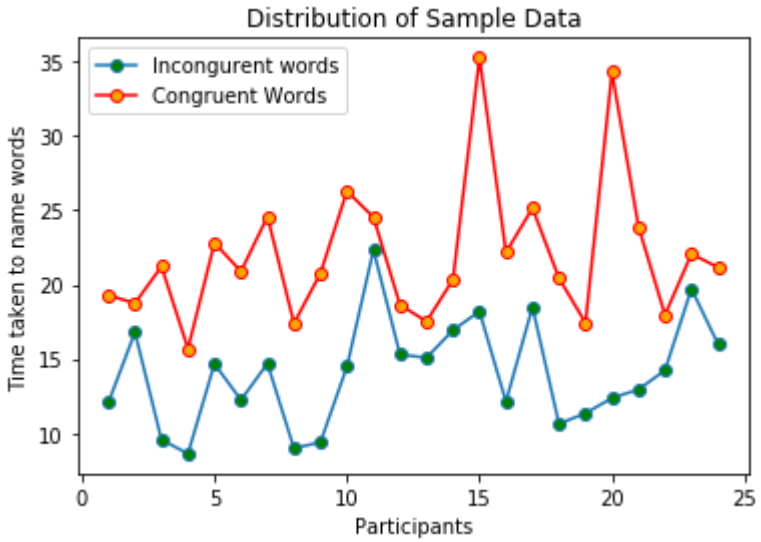
Factors for the effects observed:

- Maybe it is possible that

Alternative / similar task with similar effect:

- the qwerty and the alphabetical keypads example that was given in the lessons.
- In that example also, the users were used to use qwerrty keypads so that's why they were making more errors using with the alphabetical keypad as they were not used to it prior the task.

In [2]:
```
# Q 4
# plots to visualize the distribution of sample data

#

import matplotlib.pyplot as plt

%matplotlib inline

# data 1 is the congruent data
data_1 = [12.079, 16.791, 9.564, 8.63, 14.669, 12.238, 14.692, 8.987, 9.401, 1
4.48, 22.328, 15.298, 15.073, 16.929, 18.2, 12.13, 18.495, 10.639, 11.344, 12.
369, 12.944, 14.233, 19.71, 16.004]

# data 2 is the incongruent data
data_2 = [19.278,18.741,21.214,15.687,22.803,20.878,24.572,17.394,20.762,26.28
2,24.524,18.644,17.51,20.33,35.255,22.158,25.139,20.429,17.425,34.288,23.894,1
7.96,22.058,21.157]

# plot for the congruent data
plt.plot(range(1, 25), data_1, marker='o',
     markerfacecolor='green', markersize=6)

# plot for the incongruent data
plt.plot(range(1, 25), data_2, '-', color='red', marker='o',
     markerfacecolor='orange', markersize=6)

fig = plt.gcf()
plt.title('Distribution of Sample Data')
plt.xlabel('Participants')
plt.ylabel('Time taken to name words')
plt.legend(['Incongurent words', 'Congruent Words'], loc='upper left')
plt.show()

# Incongruent words time is always higher than the congruent words time
```



**Time taken by the participants for naming Incongruent words remains always higher than naming the congruent words.**

**Materials refered during the project:**

- plt.plot() method for plotting data in python (https://matplotlib.org/api/_as_gen/matplotlib.pyplot.plot.html)
- Statistics Placement Advisor (https://www.udacity.com/course/viewer#!/c-ud134-nd/l-4446458586/)