# Statistics: The Science of Decisions Project Instructions

## Background Information

In a Stroop task, participants are presented with a list of words, with each word displayed in a color of ink. The participant's task is to say out loud the *color of the ink* in which the word is printed. The task has two conditions: a congruent words condition, and an incongruent words condition. In the *congruent words* condition, the words being displayed are color words whose names match the colors in which they are printed: for example `RED`, `BLUE`. In the *incongruent words* condition, the words displayed are color words whose names do not match the colors in which they are printed: for example `PURPLE`, `ORANGE`. In each case, we measure the time it takes to name the ink colors in equally-sized lists. Each participant will go through and record a time from each condition.

## Questions For Investigation

**DATA SET**

| Congruent | Incongruent |
|---|---|
| 12.079 | 19.278 |
| 16.791 | 18.741 |
| 9.564 | 21.214 |
| 8.63 | 15.687 |
| 14.669 | 22.803 |
| 12.238 | 20.878 |
| 14.692 | 24.572 |
| 8.987 | 17.394 |
| 9.401 | 20.762 |
| 14.48 | 26.282 |
| 22.328 | 24.524 |
| 15.298 | 18.644 |
| 15.073 | 17.51 |
| 16.929 | 20.33 |
| 18.2 | 35.255 |
| 12.13 | 22.158 |
| 18.495 | 25.139 |
| 10.639 | 20.429 |
| 11.344 | 17.425 |
| 12.369 | 34.288 |
| 12.944 | 23.894 |
| 14.233 | 17.96 |
| 19.71 | 22.058 |
| 16.004 | 21.157 |

What is our independent variable?

The independent variable is the Congruent and Incongruent words.

What is our dependent variable?

The dependent variable is the time it takes to name the ink colors.

What is an appropriate set of hypotheses for this task?

μ1: The mean population time to say aloud incongruent words

μ2: The mean population time to say aloud congruent words

Null hypothesis: H0: μ1 - μ2 = 0

The mean population time for Congruent and Incongruent words will be equal.

Alternative hypothesis: H1: μ1 - μ2 > 0

The mean population time of the Incongruent will be significantly longer.

What kind of statistical test do you expect to perform?

I will perform a Paired T-Test.

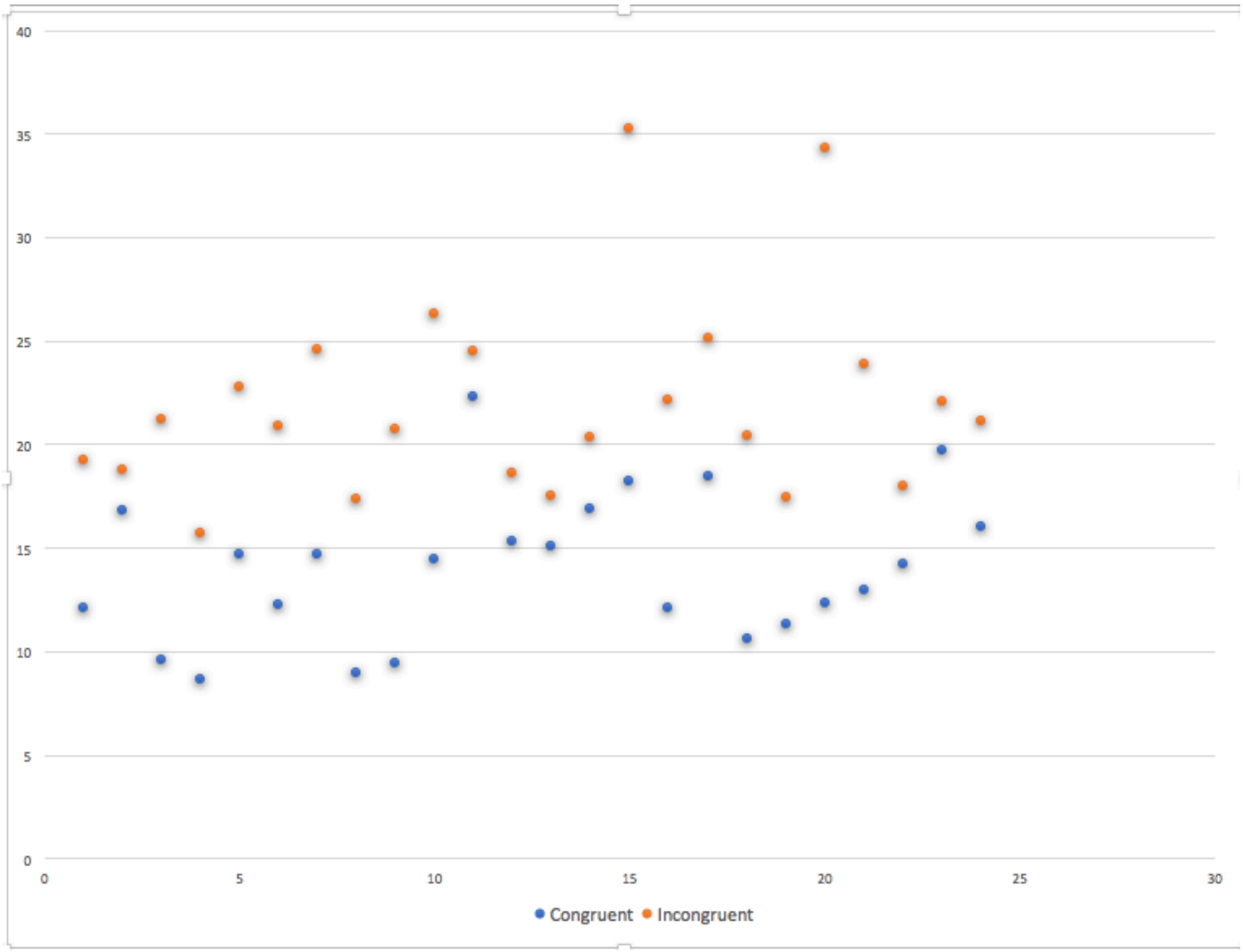
Justification: We do not know the demographics of the population. What we do know is that each participant takes the test twice, once with congruent words and once with incongruent words. Because the results of the test are related and dependent, a Paired P-Test is most appropriate.

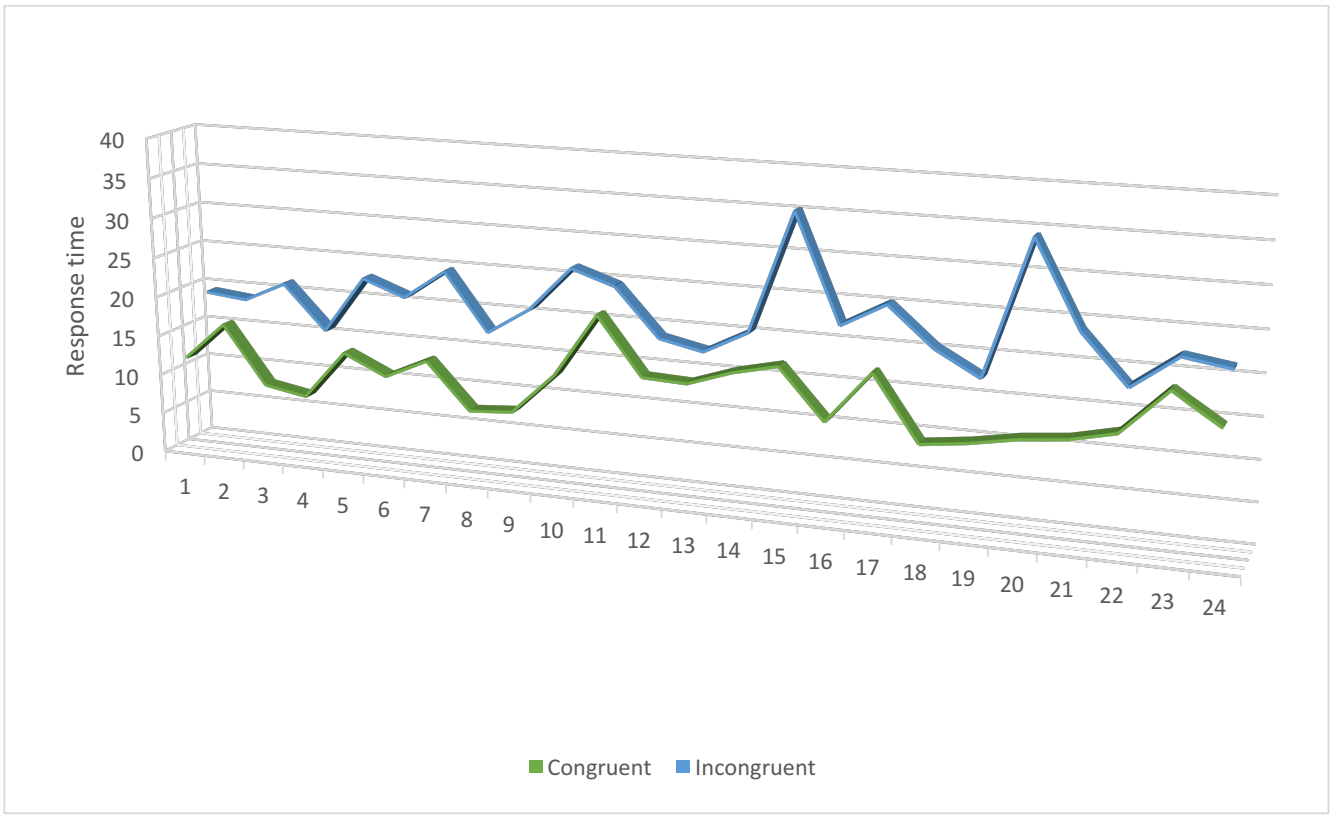
Now it's your chance to try out the Stroop task for yourself. Go to this link, which has a Java-based applet for performing the Stroop task. Record the times that you received on the task (you do not need to submit your times to the site.) Now, download this dataset which contains results from a number of participants in the task. Each row of the dataset contains the performance for one participant, with the first number their results on the congruent task and the second number their performance on the incongruent task.

Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.

| | Congruent | Incongruent |
|---|---|---|
| Mean | 14.051125 | 22.01591667 |
| Variance | 12.66902907 | 23.01175704 |
| Observations | 24 | 24 |

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.


40
35
30
25
20
15
10
5
0
0
5
10
15
20
25
30
Congruent
Incongruent


Response time
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Congruent
Incongruent

Both visualizations show a longer response time for Incongruent words. I believe this will be confirmed with the T-Test.

Now, perform the statistical test and report your results. What is your 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?

t-Test: Paired Two Sample for Means

Alpha: 0.05

| | *Congruent* | *Incongruent* |
|---|---|---|
| Mean | 14.051125 | 22.01591667 |
| Variance | 12.66902907 | 23.01175704 |
| Observations | 24 | 24 |
| Pearson Correlation | 0.351819527 | |
| Hypothesized Mean Difference | 0 | |
| df | 23 | |
| t Stat | -8.021 | |
| P(T<=t) one-tail | 2.0515E-08 | |
| t Critical one-tail | 1.713871528 | |
| P(T<=t) two-tail | 4.103E-08 | |
| t Critical two-tail | 2.06865761 | |

Based on the results of this test, it fails to reject the null hypothesis. This is passed on the p value being larger than the alpha of 0.05. The results were in line with my expectations.