

# Statistics: The Science of Decisions

## *P1 – Test a Perceptual Phenomenon*

### 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:

1. What is our independent variable? What is our dependent variable?

Based on the above information, the following variable are noted:

*Independent Variable* → Two Conditions namely Congruent and Incongruent

*Dependent Variable* → Time taken (the time taken to read out the colored words are the Dependent Variables)

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

### *Hypotheses:*

$H_0$  → The time taken for congruent condition is higher than or equal to incongruent condition.  
( $H_0: \mu_1 \geq \mu_2$ )

$H_A$  → The time taken for congruent condition is lesser than incongruent condition. ( $H_A: \mu_1 < \mu_2$ )

Where,

$\mu$  → Population Mean

$\mu_1$  → The mean time taken to read out the words in Congruent condition.

$\mu_2$  → The mean time taken to read out the words in Incongruent condition.

### Statistical Test:

Since, we have two condition present, I will use a one-tailed “**T-Test**” in the negative direction based on the alternative hypotheses that the time taken for both the tests are not the same. Also, the given sample is a dependent sample because of two conditions present.

We use a one tailed directional t-tail for our project because, our sample size is less than 30 and also the population standard deviation is unknown. Moreover, according to our hypotheses, we need to prove that the time taken for both the conditions are not the same and hence, the one tailed t-test in the negative direction implies that the time taken to read out words in the Incongruent condition is more than that of the Congruent condition.

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

### Descriptive Statistics:

#### *Congruent Condition*

$$\bar{X} = 14.0$$

Standard Deviation = 3.6 (Using Bessel's Correction)

#### *Incongruent Condition*

$$\bar{X} = 22.0$$

Standard Deviation = 4.8 (Using Bessel's Correction)

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.

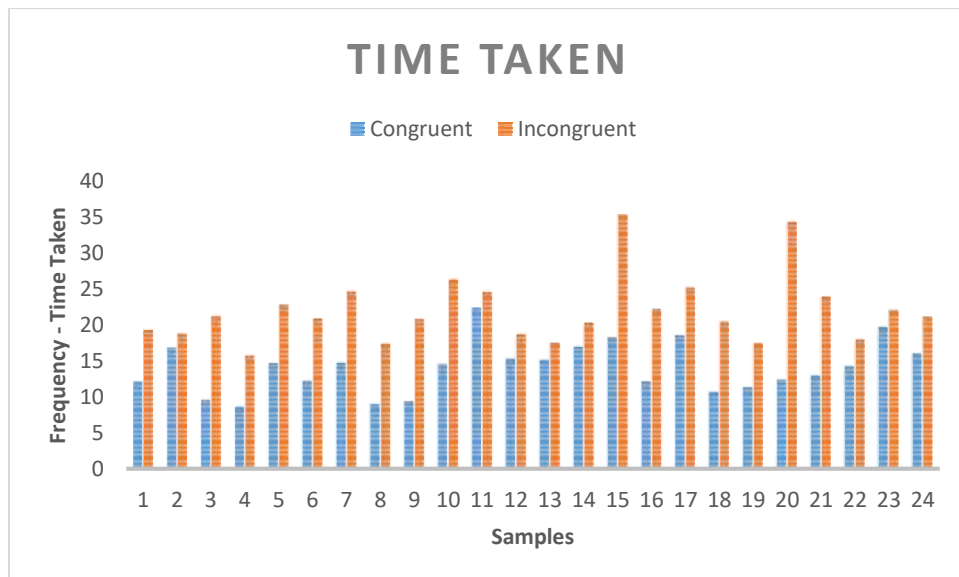


Chart - A

The above (Chart –A) visualizations depict the time taken to read the word's from both the Congruent and Incongruent conditions. Overall, we can say that the time taken to read words from the Congruent conditions is lesser than that of the Incongruent condition. The visualization below (Chart – B) depicts the difference between the Congruent and Incongruent condition.

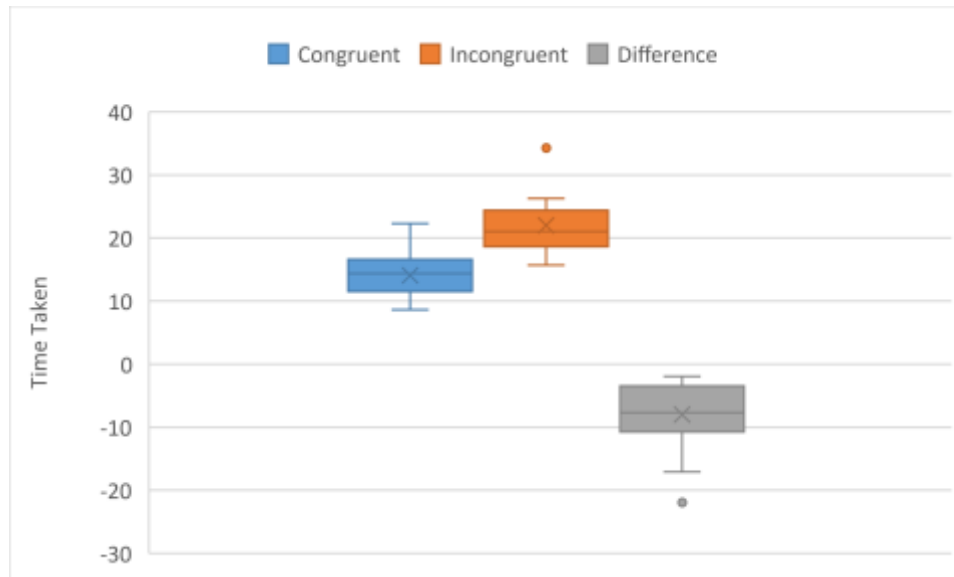


Chart - B

5. 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?

$df = 23$   
 $SEM \text{ (Standard Error of Mean)} = 0.993$   
 $\text{Mean Difference } \mu_d = -7.97$   
 $\alpha\text{-level} = 0.99 \text{ (0.01)}$   
 $t_{\text{statistic}} = -8.02$   
 $t_{\text{critical}} = -2.50 \text{ (Using t-table and considering the negative values)}$   
 $p\text{-value} = 0.0001$ , which is statistically significant  
 $\text{Cohen's } d = -1.64$   
 $R^2 = 0.74 = 74\%$   
 $MoE = 2.79$

At these values and the confidence interval of 99%, the Null Hypotheses can be rejected and we can concur that the time taken for both the Conditions are not the same.

Yes, the results did match up my expectations.

6. Optional: What do you think is responsible for the effects observed? Can you think of an alternative or similar task that would result in a similar effect? Some research about the problem will be helpful for thinking about these two questions!

The brain focuses more on reading than on the color of the words and hence the delay in time is noticed. Another task would be to change the fonts and shape of the words.