1. Dependent Variable and Independent variable

The independent variable is the condition (i.e. congruent words and incongruent words) and the dependent variable is the response/reaction time.

2.

H_0 = Null Hypothesis

H_a = Alternate Hypothesis

$\mu_{\text{Reaction time of congruent}}$ = Population mean of the reaction times under congruent test

$\mu_{\text{Reaction time of incongruent}}$ = Population mean of the reaction times under incongruent test

Null Hypothesis

There is no significant difference between the reaction times of people under congruent and incongruent test

$\mathbf{H_0: \mu_{Reaction\ time\ of\ congruent} = \mu_{Reaction\ time\ of\ incongruent}}$

Alternate Hypothesis

There is significant difference between the reaction times of people under congruent and incongruent test

$\mathbf{H_a: \mu_{Reaction\ time\ of\ congruent} \neq \mu_{Reaction\ time\ of\ incongruent}}$

I am going to perform a **paired T – test** on an alpha level .05 as a two tailed test. A **two tailed test** is necessary because we don't know whether we can perform a unidirectional test i.e. we are not aware if the reaction time will increase during the congruent / incongruent test or vice versa. So we are checking for the difference in the reaction time.

And I also think that a paired T-test is necessary because the sample are dependent i.e. reaction time of congruent condition vs. incongruent condition of the same subject. We can consider congruent and incongruent test as two treatments applied to the same subject.

Assumptions

1. Our sample size is less than 30. We have a sample size of 25 which makes T-test makes more appropriate.
2. We also don't know the population mean and standard deviation which makes it difficult to apply Z-test
3. I also assume that the distribution of data would be Gaussian.

3. Descriptive statistics

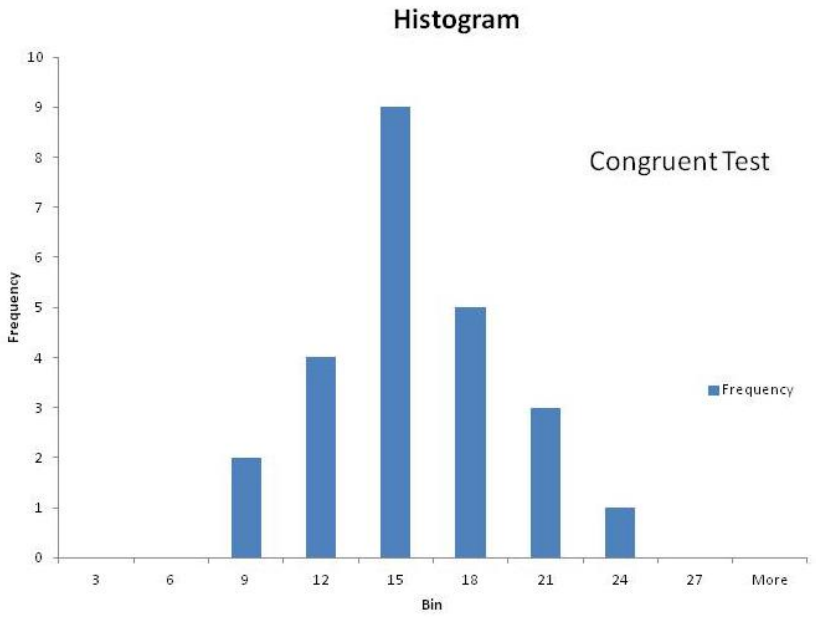
Congruent test

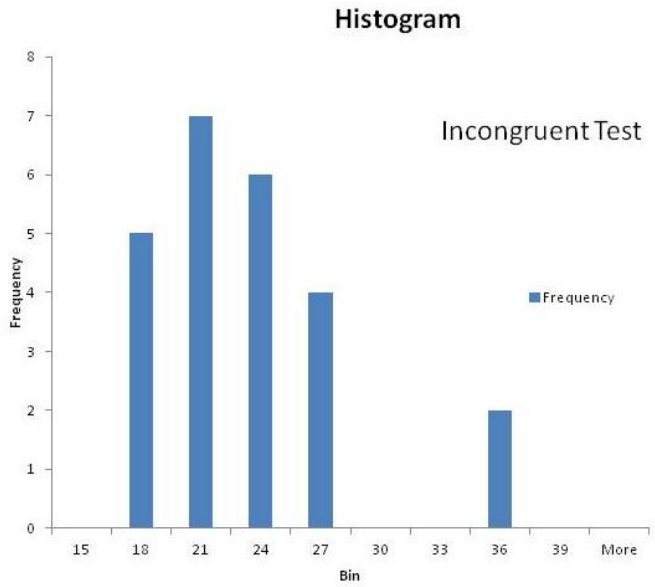
- Mean 14.05113
- Standard Deviation 3.559358
- Sample Variance 12.66903

Incongruent test

- Mean: 22.01591667
- Standard Deviation: 4.797057122
- Sample Variance: 23.01175704

4. Visualization (Histogram)





From the histogram of congruent test we can easily understand that it is a normal (Gaussian) distribution. If you look at the histogram of the incongruent test data, the distribution seems to be positively skewed. It makes sense because the incongruent test is counter intuitive and relatively only few in the population might have lesser reaction time for the test. We can see these kind of uneven positive distribution even in house hold income or IQ distribution of a large population.

5. Statistical Test

$\bar{X}_{congruent} = 14.05$

$\bar{X}_{incongruent} = 22.02$

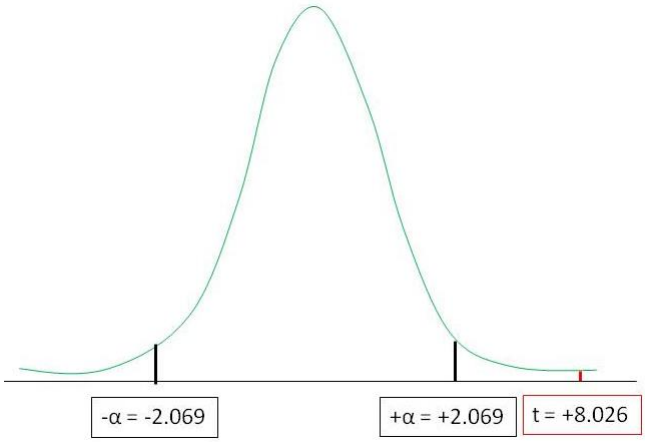
Point estimate = $\bar{X}_{incongruent} - \bar{X}_{congruent} = 22.02-14.05 = 7.97$

Standard deviation of the difference (S) = 4.865

T-Statistic = $\dfrac{\bar{X}_{incongruent} - \bar{X}_{congruent}}{S/\sqrt{n}}$

$$\frac{7.97}{4.865/\sqrt{24}} = 8.026$$

T-Critical value ($\alpha = 0.05$, dF = 23) = ± 2.069



Since the t-statistic is 8.026 and the T-Critical value (α= 0.05, df = 23) is ± 2.069 **we can reject the null hypothesis**. That means we have found that the difference between the reaction time of incongruent and congruent test is statistically significant at an α level of 0.05 (two tailed, 0.025 each tail).

Cohen's D = M_d/S_d = 1.638

Confidence Interval (95%) = $M_d \pm t_{critical} (S_d/ \sqrt{n}) = 7.97 \pm 2.069 (4.865/\sqrt{24})$

(5.915 , 10.025)

6. The difference in the reaction time of congruent and incongruent test can be attributed to the lag in "the brain's ability to recognize the color of the word since the brain reads words faster than it recognizes colors" – From Wikipedia (https://en.wikipedia.org/wiki/Stroop_effect) . This is attributed to the processing speed that is word processing is significantly faster than color processing. A variation of the game can be a pictures of animals with the same name labeled (congruent) or different name labeled (incongruent) to it. I believe we can find similar patterns of difference in the reaction time as we have observed for the current experiment.