PART 2: STATISTICS

PROJECT: Test a Perceptual Phenomenon

Statistical Analysis of Stroop Effect

Congruent (X_1)	Incongruent (X_2)	Difference
12.079	19.278	7.199
16.791	18.741	1.95
9.564	21.214	11.65
8.63	15.687	7.057
14.669	22.803	8.134
12.238	20.878	8.64
14.692	24.572	9.88
8.987	17.394	8.407
9.401	20.762	11.361
14.48	26.282	11.802
22.328	24.524	2.196
15.298	18.644	3.346
15.073	17.51	2.437
16.929	20.33	3.401
18.2	35.255	17.055
12.13	22.158	10.028
18.495	25.139	6.644
10.639	20.429	9.79
11.344	17.425	6.081
12.369	34.288	21.919
12.944	23.894	10.95
14.233	17.96	3.727
19.71	22.058	2.348
16.004	21.157	5.153

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

Ans: The independent variable is the colour of the word or **type of word** i.e. Congruent word or Incongruent word.

The dependent variable is the **time** taken for the test by the participants.

2. **A**) **Establish hypotheses**
   Ans:

   Null Hypothesis:
   There is no change in the time taken to read out the color of the ink of list of Congruent and Incongruent words. i.e.
   $H_0: \mu_c = \mu_{ic}$ *or* $\mu_c - \mu_{ic} = 0$

   Alternate Hypothesis
   $H_A: \mu_c < \mu_{ic}$

   Where, μ_c = Mean time taken to read out the color of Congruent words, by all population.
   μ_{ic} = Mean time taken to read out the color of Incongruent words, by all population.

   B) Establish a statistical test
   Ans:
   Since the size pf data = 25, hence it cannot be referred as population, but, a sample. Hence we will perform t-test over these two samples. Since these are independent samples, so we will perform 2-sample t-test. We will analyze weather time taken for reading confruent words is lesser or not.
   We will perform, **One-Tail t-test, α = 0.05**

3. **Report descriptive statistics**
4. **Plot the data**

Ans: Figure 1, shows the comparative histogram plot of time taken by participants in Stroop-test. The comparison is performed between Congruent word test and Incongruent word test. It clears shows that histogram for Incongruent test sample is shifted toward right indicating a larger mean time.

Calculating Central Tendencies and Variability:

Congruent Sample

Mean = $\bar{X}_1$ = **14.05**

Mode Range = Mo_1 = **12-13 sec**

Variance, **VAR_1 = 12.67**

Standard Deviation, **SD_1 = 3.56**

Incongruent Sample

Mean = $\bar{X}_2$ = **22.02**

Mode Range = Mo_2 = **17-18 sec & 20-21 sec**

Variance, **VAR_2 = 23.01**

Standard Deviation, **SD_2 = 4.8**

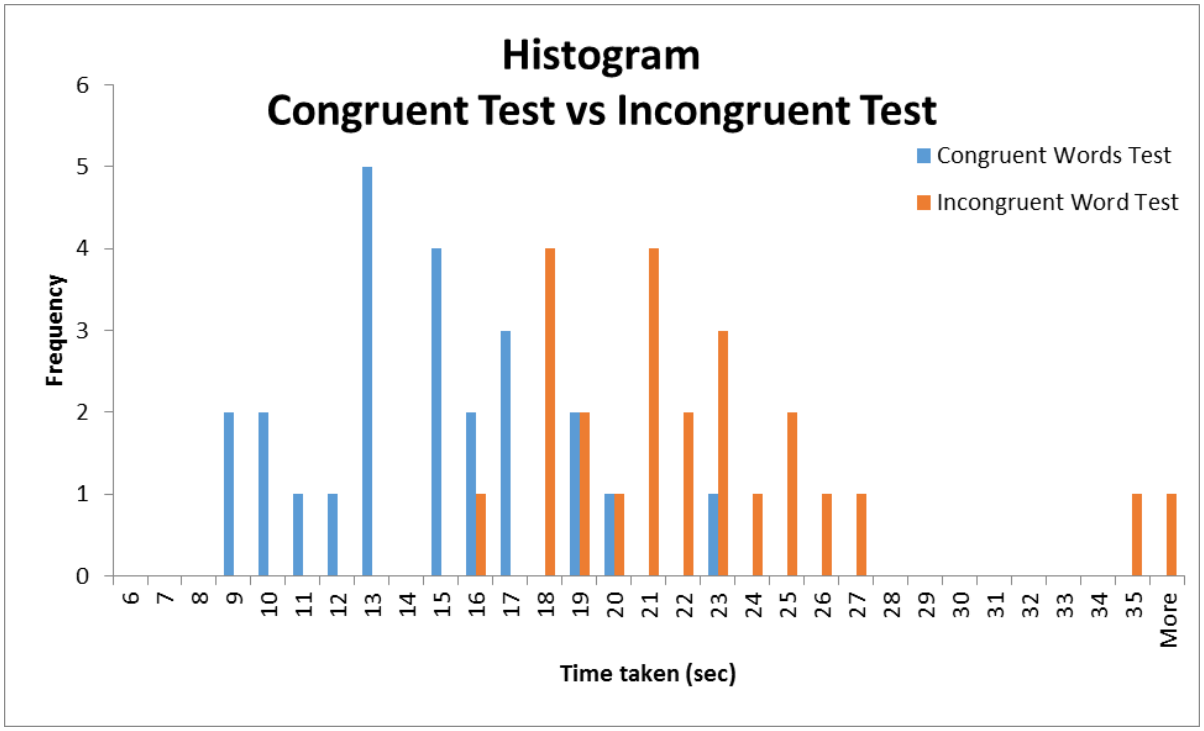

Figure 1: Comparison of Histogram of samples from Congruent word test and Incongruent word test

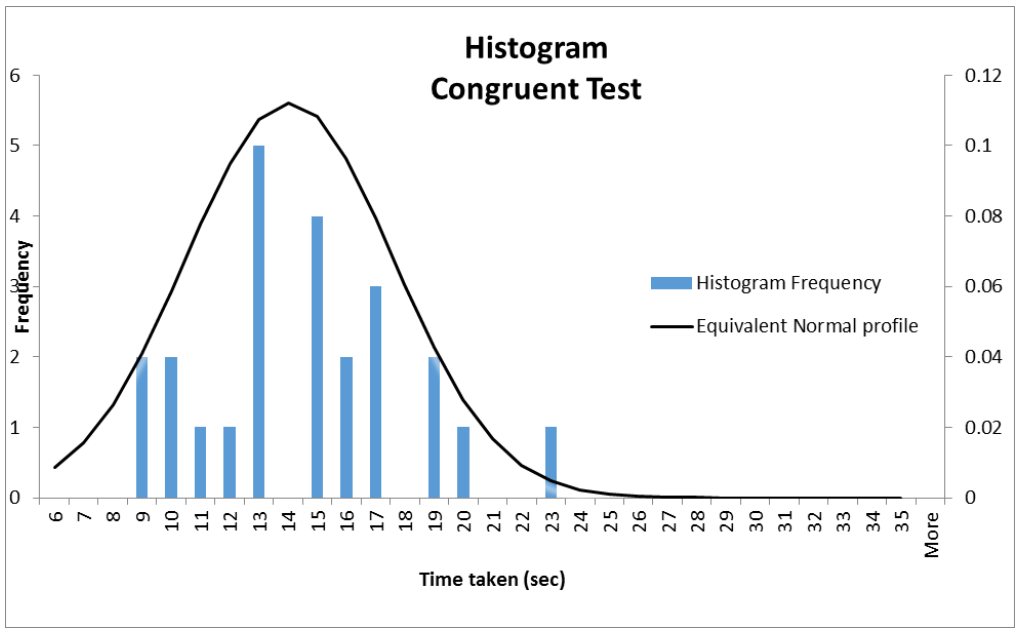

Figure 2: Plot showing histogram and equivalent normal distribution for Congruent word test

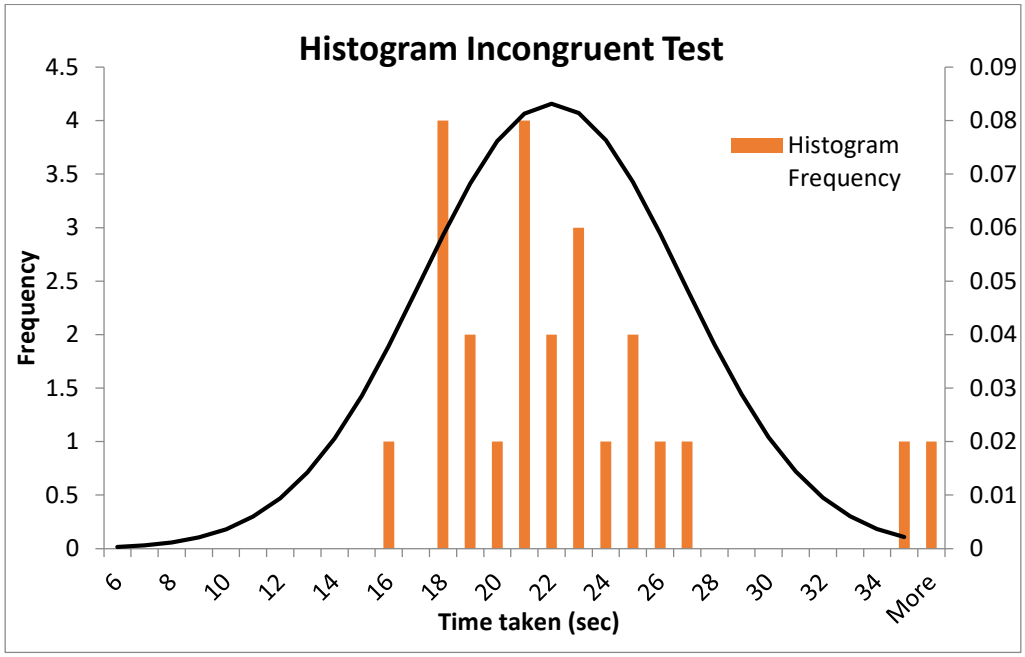

Figure 3: Plot showing histogram and equivalent normal distribution for Congruent word test

Fig.2 and Fig.3 shows histogram profile and equivalent normal distribution profile for data obtained from Stroop test. The normal curve is built using Mean ($\bar{X}$) and Standard deviation (**SD**) of the particular sample. Fig. 4 shows the comparison of the equivalent normal curve for the two test.

It can be inferred that:

- Incongruent test curve is more spread than the congruent test curve. This is also confirmed by the results obtained in section 3.
- The higher mean obtained in section 3, is depicted in Fig. 1 and Fig. 4 as the Incongruent test curve shifted to the right.

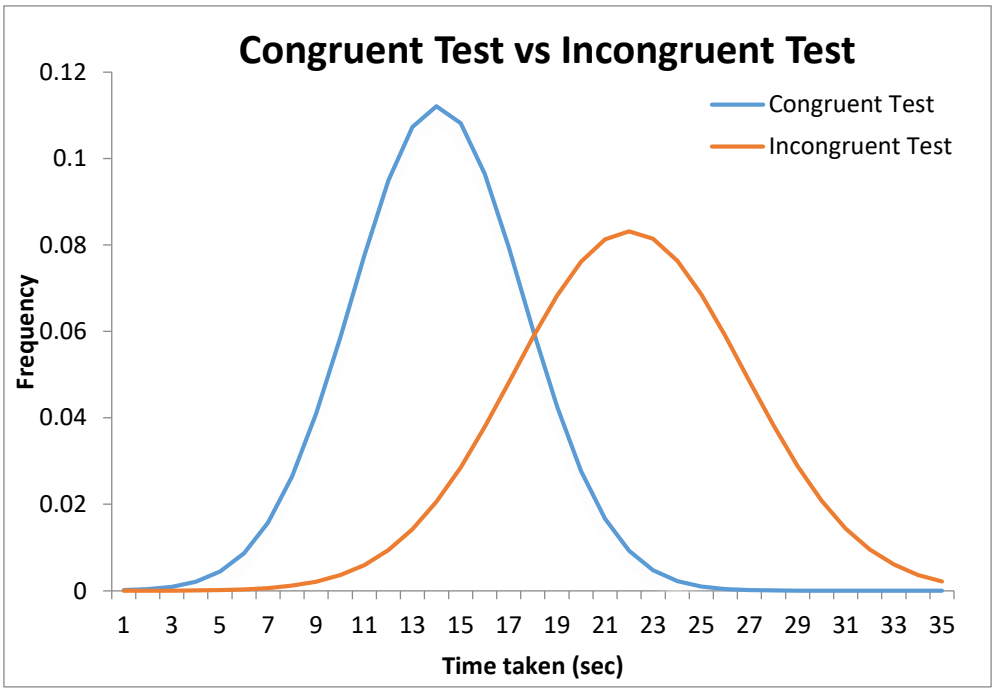

Figure 4: Comparison of equivalent normal curve for the two test

5. Perform the statistical test and interpret your results

Ans:

Performing One tail t-test on the two independent samples.

Degree of freedom, **df** = 24+24-2 = 46

$\bar{X}_1$ = **14.05**, $\bar{X}_2$ = **22.02**

SD_1 = 3.56, SD_2 = 4.8

Standard Error, SE = $\sqrt{\frac{SD_1^2+SD_2^2}{n}} = \sqrt{\frac{3.56^2+4.8^2}{24}} = 1.219$

Now, **t-statistics** = $\frac{\bar{X}_2 - \bar{X}_1}{SE} = \frac{22.02 - 14.05}{1.219} = 6.532$

Hence, **t (46) = 6.532, p < .0001, One-tailed**

t-critical (Alfa = 0.05, df = 46, 1-Tail)**= t_c = 1.676**

Confidence Interval= $\bar{X}_2 - \bar{X}_1 \pm t_c * SE$

= 7.964 $\pm$ 1.676*1.219 = **[5.921 , 10.008]**

Hypothesis Test:

Since p < .0001, Hence Null Hypothesis, $H_0: \mu_c = \mu_{ic}$ is rejected. And Alternate Hypothesis, $H_0: \mu_c < \mu_{ic}$ is accepted for One-tail, 95% confidence and α = 0.05

Note: It can be concluded that the Null hypothesis is rejected even for **α = 0.001. Hence, there is significant lesser time taken for the Stroop test with Congruent words, compared to that of Incongruent words.**

The **Results were as expected** from the inference we received by studying visual profile of the sample distributions from two test.

6. Hypotheses regarding the reasons for the effect observed are presented. An extension or related experiment to the performed Stroop task is provided, that may produce similar effects.

Ans: The words have a very strong ability to say the color. We tend to read the words much faster than just catching its color. The interference happening due to different information received from word and its color is due to following reason:

a) Speed of Processing Theory: the interference occurs because words are read faster than colors are named.
b) Selective Attention Theory: the interference occurs because naming colors requires more attention than reading words.

More possible experiment related to Stroop effect are:

- Turn the words upside down or rotate them 90 degrees.
- Use non-color words such as "dog" or "house."
- Compare long words to short words.
- Use emotional words such as "sad" or "happy" or "depressed" or "angry."
- Color only half of the word or color only the first and last letter of each word.

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