Statistical Analysis of Stroop Effect

Questions For Investigation

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

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

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

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.

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?

Answer 1

The independent variable here is the Color Congruency Condition Test being done on participants. (X-axis)

The amount of time it takes to name the ink colors of a 'word', will be a dependent variable, measured on y-axis.

The amount of time it took for each participants to complete two tests would vary from participants to participants, this depends on the Color Congruency Condition Test (x-axis), congruent test and incongruent test, being done on them.

Answer 2a

Population Mean of Congruent test = μ_{cong}

Population Mean of Incongruent test = μ_{incong}

Since we want to know whether there was a significant change of time in both tests we will set the null and alternative hypothesis as following:

Null Hypothesis $H_0 : \mu_{cong} = \mu_{incong}$ *(Fail to reject the null)*

The null hypothesis states that there's not much significant change in means between two tests, congruent and incongruent, depending on the Confidence Interval (CI) or alpha level (α) we set for the test. If the t-statistics is within the CI, we 'Fail to reject the null', means there's not significant difference between the means of congruent and incongruent tests.

Alternative Hypothesis $H_a : \mu_{cong} \neq \mu_{incong}$ *(Reject the null)*

The alternative hypothesis being opposite of null, states that there is a significant change in means between congruent and incongruent tests. The t-statistic being outside the CI or being inside an alpha region we 'Reject the null'. Hence, accepting the alternative hypothesis.

Answer 2b

We would set two-sided test of hypothesis at the confidence interval of 95% or alpha level of 5%. 2.5% of extreme data points on either side will be in critical region.

Since the sample size is less than 30 we would use t-test because this is no longer normally distributed. If it had sample size of more than 30, than the distribution would be normal and we would use z-test to figure out how many standard deviation away the mean is.

This is a longitudinal Dependent one sample.

Answer 3

Central Tendency Measures of the following data:

Calculating the mean of Congruent test time

1. *Taking the sum of all the values = 337.227*
2. *Diving by the number of sample size = 24*
3. *The mean of Congruent Sample (μ_{cong}) = 14.05 (Rounding to the nearest hundredths place)*

Calculating the mean of Incongruent test time

1. *Taking the sum of all the values =* 528.382
2. *Diving by the number of sample size = 24*
3. *The mean of Congruent Sample (μ_{cong}) = 22.02 (Rounding to the nearest hundredths place)*

Calculating the median of Congruent test time

1. *Sorting the range of values in ascending order.*
2. *Since sample size is an even number, we will have two middle values, 14.233 and 14.48 at the position 12 and 13 respectively.*
3. *We add these values and divide it by 2.*
4. *The median of Congruent test time (μ_{cong}) = 14.36 (Rounding to the nearest hundredths place)*

Calculating the median of Incongruent test time

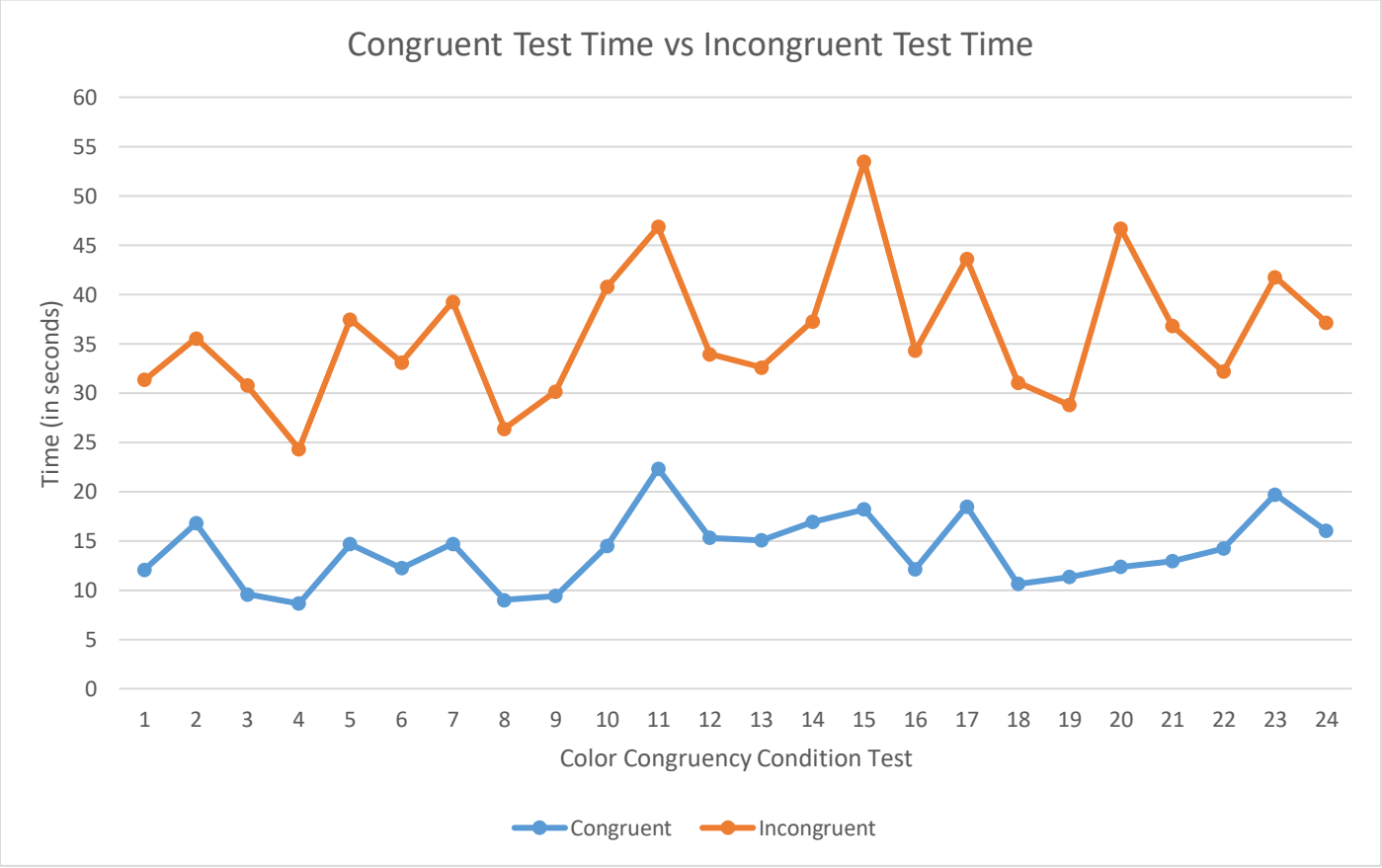
1. *Sorting the range of values in ascending order.*
2. *Since sample size is an even number, we will have two middle values, 20.878 and 21.157 at the position 12 and 13 respectively.*
3. *We add these values and divide it by 2.*
4. *The median of Congruent test time (μ_{cong}) = 21.02 (Rounding to the nearest hundredths place)*

Variability Measures of the following data :

Estimated Population Standard Deviation (Bessel's correction) = σ = 4.86

Standard error $= \frac{\sigma}{\sqrt{n}} =$ *0.99 (sample size (n) = 24)*

Answer 4



The data plot above was created by a Line plot and as you can see that all 24 participants who took the test of stroop effect have a common change, the increase in total time in the incongruent test. The time it takes to complete the incongruent test by participants is far more than congruent test. It takes approximately 15-20 seconds more for the participants to complete incongruent test. This does graphically prove that 'stroop effect' really effects our reaction time!

Answer 5

Average time taken by participants in Incongruent test :

$\mu_{incong} = 22.02$

Average time taken by participants in congruent test :

$\mu_{cong} = 14.05$

Estimated Population Standard Deviation (sd) $= 4.86$

Sample Size (n) $= 24$

Standard Error (SE) $= 0.99$

$$\boldsymbol{t\ statistics} = \frac{\mu_{incong} - \mu_{cong}}{sd/\sqrt{n}} = 8.02$$

At an alpha level of 0.5 (5%), t critical value $= \pm 2.069$

Two-tailed p value is < 0.0001

95% of Confidence Interval (CI) for the difference:

$(5.91, 10.01)$

Do we Reject or Fail to reject the null?

Since the t-statistic lies in the critical region, we can say that the time it took to say the name of the colors in incongruent test is far greater. **Hence, we Reject the null hypothesis!** This means that the samples statistics are statistically different for the CI level that we set. This also means that we accept the alternative hypothesis for this test. But yet this doesn't really prove that there will always be a significant statistical differences between the color congruency tests.

THE END