Test a Perceptual Phenomenon

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

- Independent variable is the **type of congruency (Congruent with ink colours and Incongruent with ink colours).**

- Dependent variable is the **time taken to name the colour of the inks in which the words are displayed.**

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

Let's consider the sample mean time of incongruent words to be $\bar{x}_I$. Similarly, it's $\bar{x}_C$ for congruent words.

- **Null hypothesis H_o : $\mu_I < \mu_C$**
  The null hypothesis in this case refers to the population mean of time taken to recognise incongruent inked words will be less than the time taken for congruent words.

- Alternative hypothesis can be **H_A** :

  - $\mu_I = \mu_C$
    There could be possibility that time taken to recognise incongruent words will match the time taken for the other type.

  - $\mu_I > \mu_C$
    As we observe from the samples, The mean of time taken to recognise incongruent inked words was more than the time taken for congruent words. We will need to prove this.

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- Since these are two dependent samples, we can perform t-Tests to calculate the variability between the samples. This can confirm if Stroop effect shows interference in measured time between the samples.

- We are performing t-tests mainly for these reasons :

  • Population standard deviation is not calculated or not feasible.

  • There are less than 30 samples

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

- Measures of central tendency : Mean is the appropriate value to calculate. Therefore, $\bar{x}_C$ = **14.05** and $\bar{x}_I$ = **22.02**

- Standard Deviation : SD_C = 3.56 and SD_I = 4.80

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.
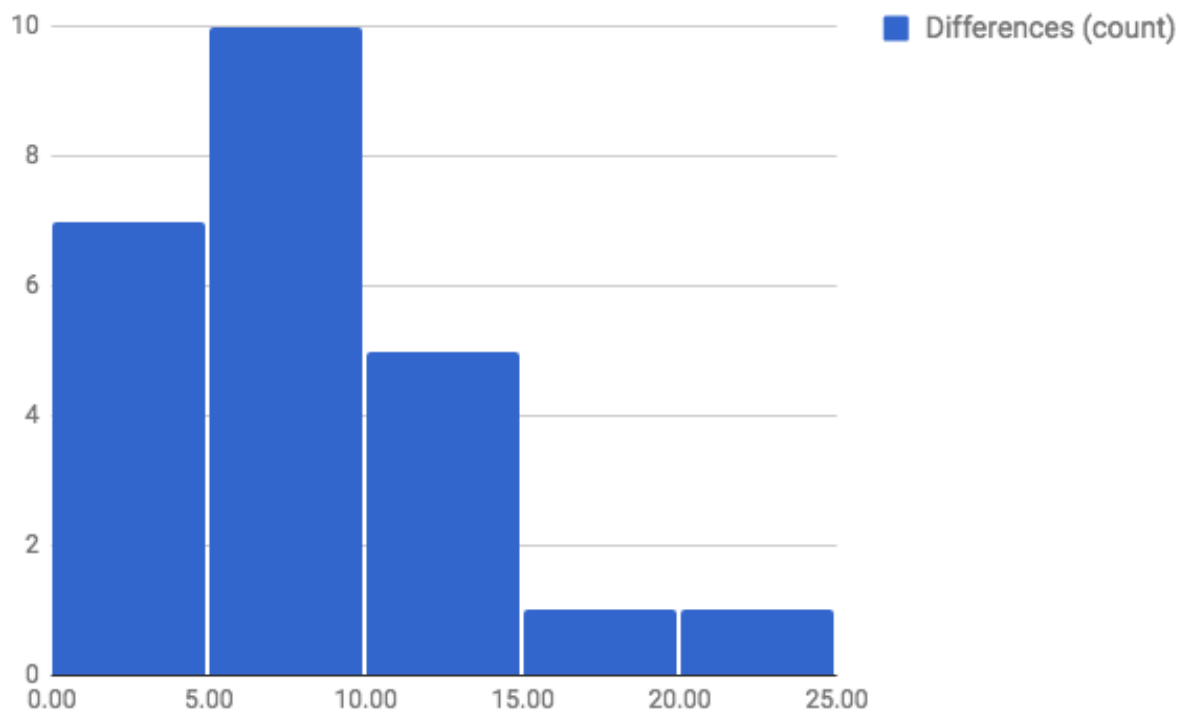
      (Note : y - axis and x-axis is the serial number in ascending order of 24 samples is the time taken to read the set of words.)

- The above graph is histogram of differences which tends to have a normal distribution.

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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?

- As we know $\bar{x}_C$ = **14.05** and $\bar{x}_I$ = **22.02**

  • Point estimate : $\bar{x}_C$ - $\bar{x}_I$ = **-7.97**

- Standard Deviation of differences : s = **4.87**

- t-Statistic : - **8.018**

- t-Critical values : **± 2.069** for DF = 23 and α = 0.05 (Two tailed)

- As seen in the figure, t-Statistic lies below the critical values. p-value < α.
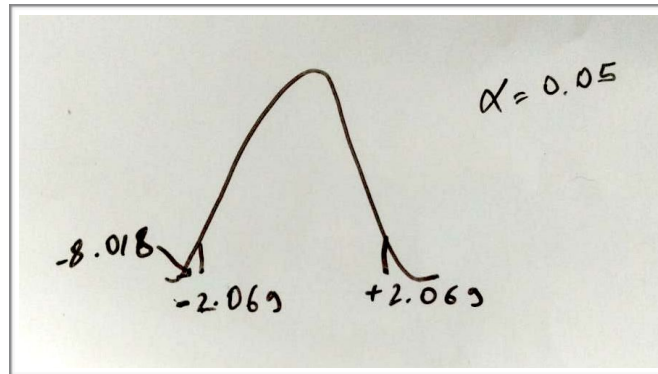
- Therefore we **reject the null hypothesis H₀**.

- We can now safely say that alternative hypothesis **H_A** is true. We have also seen that incongruent samples has higher values of time. It matches the expectations.

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6. 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!

- It's a psychological effect and probably brain processes for more time to identify the correct colour. It's based on the idea that brain processes the words faster than it processes the colours.

- Pictures or Polygon Shapes can be used instead of words. They also exhibit similar effects.

  For more info : https://link.springer.com/article/10.1007/BF00419659