Project: Test a Perceptual Phenomenon

Background 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 variables? What is our dependent variable?**
   The independent variable is whether the word is congruent word or an incongruent word. And, dependent variable in this case is the reaction time or the time taken by each participant to complete the stroop task.

2. **What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices.**
   Explanation of set of hypotheses that i used and their symbols:-

   - H_0(null hypothesis)
   - H_A(alternative hypothesis)
   - μ_{con}(population mean of congruent words group)
   - μ_{in}(population mean of incongruent words group)

   H_0: μ_{con} - μ_{in} = 0
   ➔ The null is that there is no difference in the time taken by the participant in congruent word condition and incongruent word condition. (i.e. the population mean of congruent words group and incongruent words group is same).

   H_A: μ_{con} - μ_{in} ≠ 0
   ➔ The alternative hypothesis is that there is a difference in reaction time in these two conditions (i.e. either the average time taken in reaction time of incongruent words group is less than or greater than the congruent words group).

   I expect to use two-tailed dependent t-test.

   Why two-tailed?
   ➔ To check whether two means were significantly different.

   Why t-test?
   1. Because population standard deviation is unknown.
   2. Because our sample size is less than 30 (here, n=24). [1]

Why dependent t-test?

➔ Because our test is an example of "repeated measure" statistical test. (i.e. the same participant is used in both cases. [2]

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.

Congruent and Incongruent
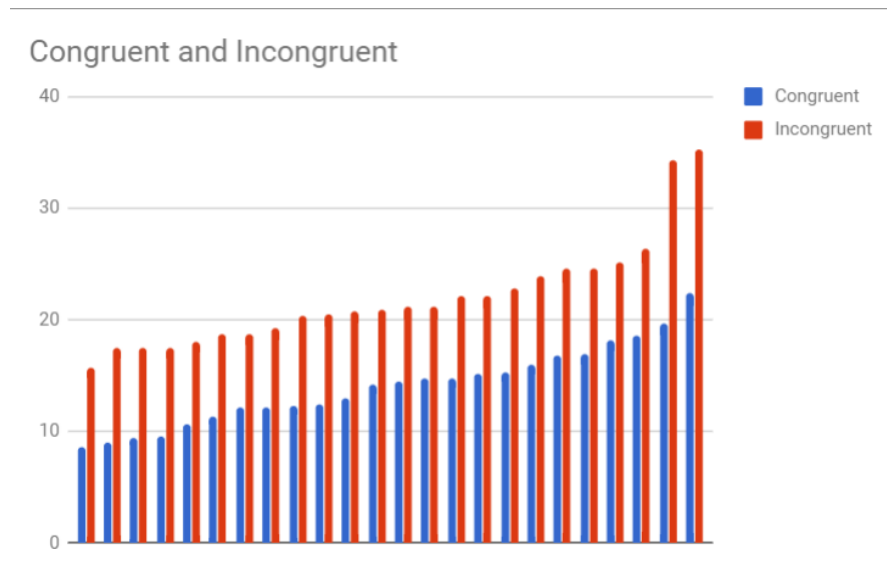
➔ **The above bar graph shows that the time taken in case of incongruent words is always greater than that of congruent words.**

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?**
   $n = 24$
   $df = n - 1 = 23$
   $\alpha = 0.05$
   $S = 4.865$
   $SEM = 0.9930 \ \{S/\sqrt{n}\}$
   $t_{critical} = \pm 2.069$
   $t_{statistics} = -8.021 \ \{(\mu_{con} - \mu_{in}) / SEM\}$

   $t_{statistics}$ fall under critical region. Hence, we reject the null. This means the participant need significantly less time in congruent words case than in incongruent words case.
   Yes, the result match up with my expectation.

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!**
   There are two theories that may explain the Stroop effect:-

   I.   Speed of Processing Theory: the interference occurs because words are read faster than colors are named.
   II.   Selective Attention Theory: the interference occurs because naming colors requires more attention than reading words.[3]

   An alternative of Stroop effect is **"Number Stroop"** effect.
   In this experiment you are required to count the number of words in each box, Do NOT say what the word says.[4]

References:-

1. http://www.differencebetween.net/miscellaneous/difference-between-z-test-and-t-test/
   (summary: point 2)
2. https://statistics.laerd.com/statistical-guides/dependent-t-test-statistical-guide.php
3. https://faculty.washington.edu/chudler/words.html
4. https://faculty.washington.edu/chudler/java/readyn.html