Statistics: The Science of Decisions Project Instructions

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

As a general note, be sure to keep a record of any resources that you use or refer to in the creation of your project. You will need to report your sources as part of the project submission.

1. What is our independent variable? What is our dependent variable?
   The independent variable is the congruent and incongruent type of task.
   The dependent variable is the time cost on name the ink colors of words.

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

Now it's your chance to try out the Stroop task for yourself. Go to this link, which has a Java-based applet for performing the Stroop task. Record the times that you received on the task (you do not need to submit your times to the site.) Now, download this dataset which contains results from a number of participants in the task. Each row of the dataset contains the performance for one participant, with the first number their results on the congruent task and the second number their performance on the incongruent task.

μC : congruent population response time means.

μI : incongruent population response time means

Hypothesis: H0: μC>=μI

HA: μC<μI

Assumptions of statistical test:

1. We have less than 30 samples.

2. We don’t know the population's standard deviation.
3. We assume that the time on test distribution is Gaussian. The difference time of one sample on congruent and incongruent test distribution is Gaussian.
4. We assume one sample is one participant, who did one time congruent test and one time incongruent test.
5. The congruent/incongruent tests are random. The participants are randomly selected.

The general rule of thumb for *when* to use a t score is when your sample size meets the following two requirements:

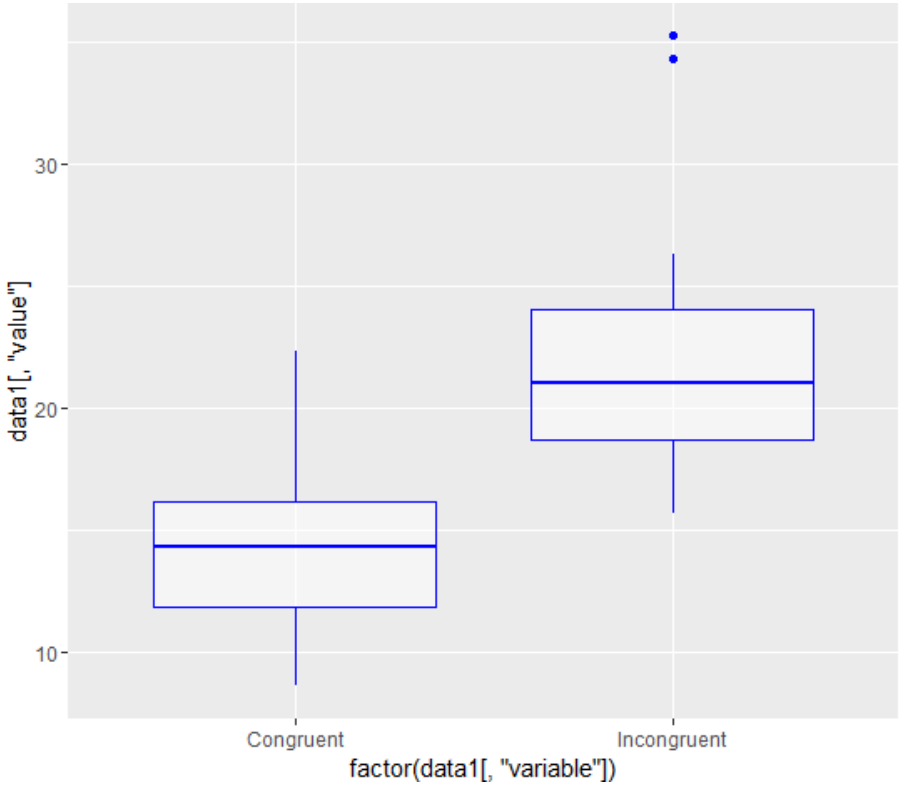
1. The sample size is below 30
2. The population standard deviation is unknown (estimated from your sample data)

So we use t score to test hypothesis.

3. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.
   The mean of time on congruent task:14.05
   The mean of time on incongruent task:22.02
   The std of time on congruent task:3.56
   The std of time on incongruent task: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.

   We plot a boxplot to show distribution of sample data. We see that Incongruent task time mean is higher than congruent task time mean.



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?
    1. Calculate di=yi-xi between the two observations on each pair.
    2. The mean difference $\mathrm{d_{bar}}$=-7.96
    3. Standard deviation of the difference,sd=4.86,SE($\mathrm{d_{bar}}$)=sd/ $\sqrt{n}$ =4.86/ $\sqrt{24}$=0.99
    4. $\mathrm{T} = \mathrm{d_{bar}}/\mathrm{SE}(\mathrm{d_{bar}})$=-7.96/0.99=-8.04
    5. t-critical (on alpha=0.01,one-tailed,df=22) =-2.5083
    6. t-statistic<t-critical
    7. we reject null hypothesis, we have 99% confidence that time on congruent task is less than time on incongruent task, which meets our expectation.
    8.

    Confidence interval: -7.96-2.51*0.99,-7.96+2.51*0.99
    (-10.44,-5.48)
    You can see CI upper limit is lower than 0, also we have 99% confident that time on congruent task is less than time on incongruent task.

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!

    We measure effect size by cohen'd
    =(difference of means)/(sd)
    = (-7.96)/(4.86))=-1.64
    We measure effect size by r^2:
    =(t-statistic^2)/(t-statistic^2+df)
    =(8.04^2)/(8.04^2+22)=0.746 =74.6%
    74.6% of variation in difference time on congruent and in congruent tasks is explained by congruent and incongruent.
    The participants obviously be an important factor influent the result. In a sample the congruent task and the incongruent task should be completed by the same participant.
    Another factor can influent result is the group. In congruent task, all words are congruent. Participants know about this ahead. They simply read out the words in congruent tasks. While in incongruent task, all words are incongruent. Participants know about this ahead, they simply discard the words and only identify the color. I think the group is a condition which can influence the result of the experiment. If we randomize the congruent words and incongruent words, we can have more reliable result of the experiment.