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 words condition, congruent, or incongruent?

The dependent variable is the time it takes to name the ink colors in equally sized lists in each of the two cases.

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

H_0: The time it takes to name the ink colors in equally sized lists in each of the two cases is the same.

H_A: The time it takes to name the ink colors in equally sized lists differs with each other in the two cases.

T-test will be adopted in this research. Because σ and μ are unknown and the samples

are quite small.

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

Congruent: mean, 14.05; median, 14.36; range, 13.7; sample standard deviation, 3.56.

Incongruent: mean, 22.02; median, 21.02; range, 19.6; sample standard deviation, 4.80 [1, 2].

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.

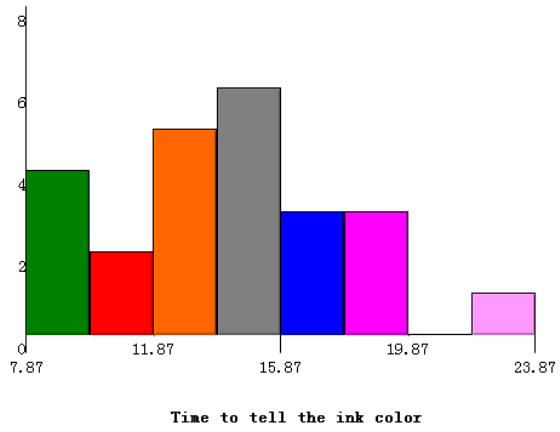

Fig.1 The distribution of the sample data for congruent case

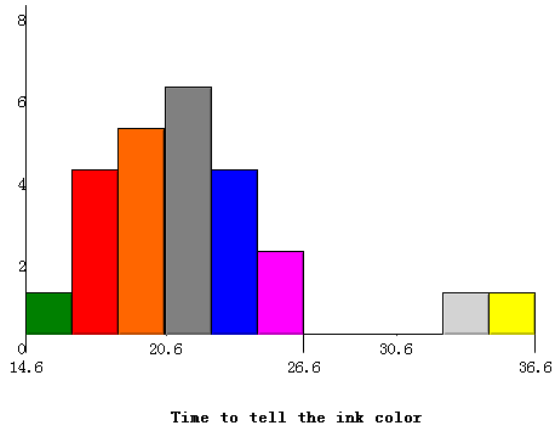

Fig.2 The distribution of the sample data for incongruent case

The time of the congruent case gather around 14 s, and the mode for this distribution is 13.87-15.87. The time distribution of the incongruent case is more dispersive than

the congruent group, and the mode for this distribution is 20.6-22.6.

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?

The sample mean of congruent case, $\bar{x}_C$=14.05

The sample variance of congruent case, S_C^2=12.67

The sample mean of incongruent case, $\bar{x}_i$=21.02

The sample variance of incongruent case, S_I^2=23.01

The standard error of the samples, $SEM = \sqrt{\frac{S_C^2}{n_1} + \frac{S_I^2}{n_2}} = 1.22$

α=0.05 is selected as the critical level for a two-tailed test, and the confidence level is 0.95. The degree of freedom is 46. Thus, the t value of the critical region can be found from the t-table [3].

$$t_c = \pm 2.01$$

The t-score of the samples, $t = \frac{\bar{x}_C - \bar{x}_I}{SEM} = -6.53$

As the t-score of the samples is far less than the t critical value, we reject the hypothesis H_0.

Conclusion: it takes more time to name the *color of the ink* in incongruent words condition than in congruent words condition. The result matches 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!

For the incongruent group, there are two sort of information to indentify, color and meaning of the word which will cause some confusion for us to name the target. For the congruent case, there are no such problems.

A similar task is as follow:

The time it takes to identify the movement orientation of a certain number of mobile arrows. The task has two conditions:

Case one: the direction of the arrow is the same with the movement orientation.

Case two: the direction of the arrow is not necessarily the same with the movement orientation.

p.s. the number of the mobile arrows are fixed for the two cases.

References

1. Yolanda Williams. What Is Descriptive Statistics? - Examples & Concept. http://study.com/academy/lesson/what-is-descriptive-statistics-examples-lesson-quiz.html

2. Measures of variability: the range, inter-quartile range and standard deviation. http://www2.le.ac.uk/offices/ld/resources/numerical-data/variability

3. t distribution critical values. https://s3.amazonaws.com/udacity-hosted-downloads/t-table.jpg