

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 list words in different conditions (congruent/incongruent). The dependent variable is the time it takes to name the ink colors in above mentioned conditions.

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

Sample size $n = 24$; confidence interval is 95%

H_0 (null hypothesis): $\mu_c = \mu_i$

μ_c is the population mean of time for naming ink color for congruent words;

μ_i is the population mean of time for naming ink color for incongruent words.

The null hypothesis is that population means of time in both congruent and incongruent conditions are equal. Simply put, the time it takes to name the ink color of words in congruent condition is equal to that under incongruent condition.

H_1 (alternative hypothesis): $\mu_c \neq \mu_i$

μ_c is the population mean of time for naming ink color for congruent words;

μ_i is the population mean of time for naming ink color for incongruent words.

The alternative hypothesis is that population means of time in congruent and incongruent conditions are NOT equal. Simply put, the time it takes to name the ink color of words in congruent condition is NOT equal to that under incongruent condition.

We will infer population parameters and conduct dependent t-test for paired samples to validate above hypothesis given that:

- Population parameters for both congruent and incongruent conditions are unknown
- Sample size 24 is small (<30) \Rightarrow t-test is suitable

- It's a fact that the data is derived from same group of participants performing two different tasks => dependent t-test for paired sample
- Only interested in whether $\mu_c \neq \mu_i$ => two-tailed test is suitable

Lastly we assume that distributions of both congruent and incongruent data are Gaussian.

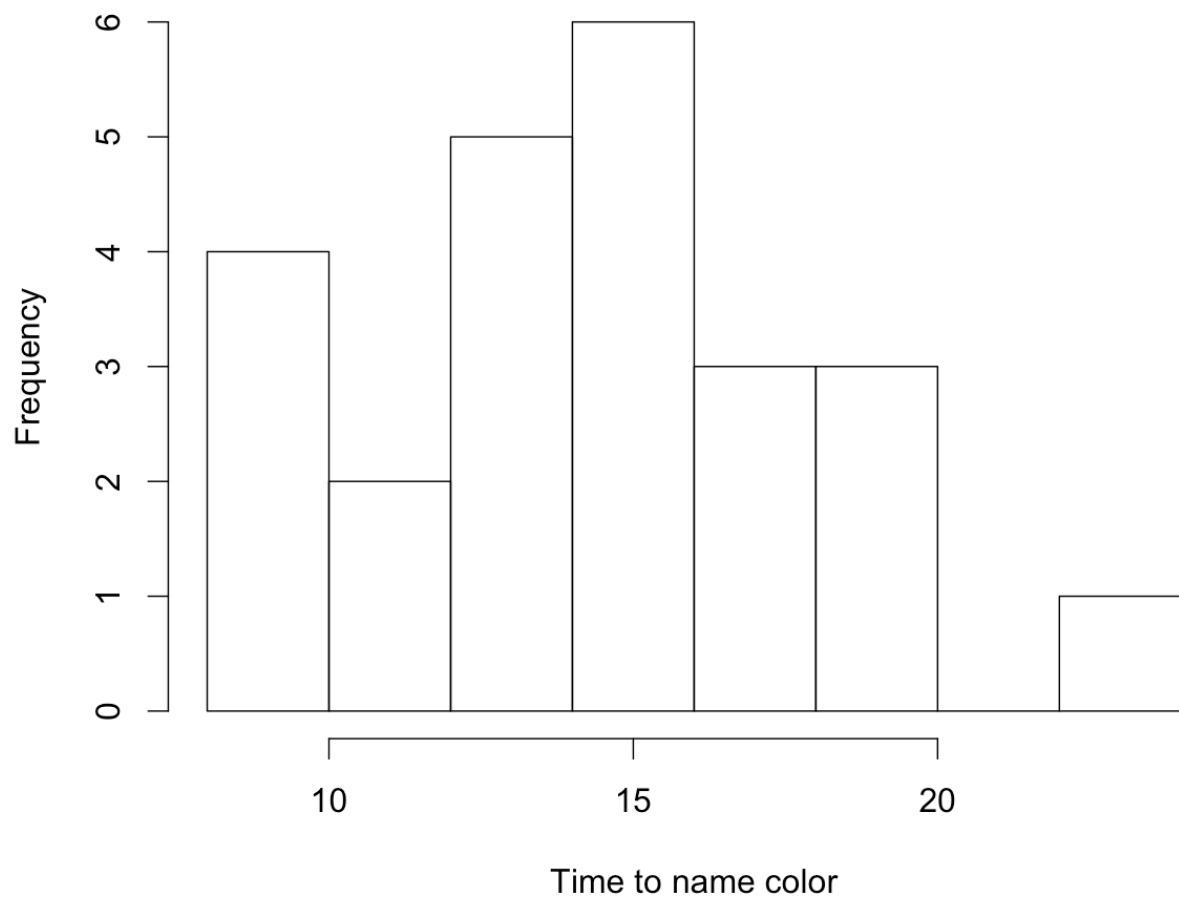
Now it's your chance to try out the Stroop task for yourself. Go to [this link](#), which has a Java-based applet for performing the Stroop task. Record the times that you received on the task (you do not need to submit your times to the site.) Now, download [this dataset](#) which contains results from 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.

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

Condition	Min	1 st Qu.	Median	Mean	3 rd Qu.	Max	Sample SD
congruent	8.63	11.90	14.36	14.05	16.20	22.33	3.56
Incongruent	15.69	18.72	21.02	22.02	24.05	35.26	4.80

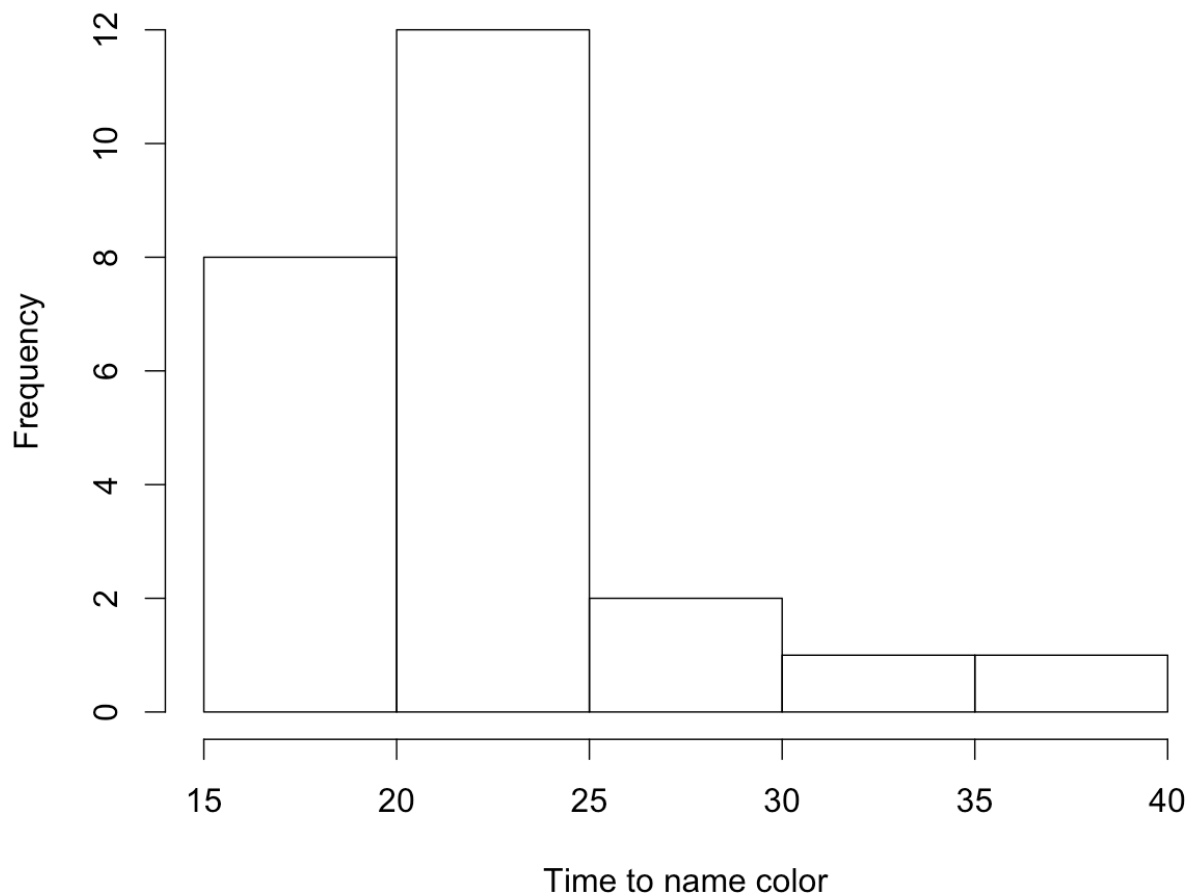
4. Provide one or two visualizations that show the distribution of the sample data. Write one or two sentences noting what you observe about the plot or plots.

Stroop Congruent Task



Above plot is the histogram of Stroop task in Congruent condition. The distribution is slightly skewed and with most frequent time around 14~15.

Stroop Incongruent Task



Above plot is the histogram of Stroop task in Incongruent condition. The distribution is skewed (more skewed compared with Congruent task) and with most frequent time around 20~25.

- 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 explained in Q2, dependent t-test for paired samples approach is used as following.

H0(null hypothesis): $\mu_c = \mu_i$

H1(alternative hypothesis): $\mu_c \neq \mu_i$

Sample size $n = 24$; confidence interval is 95%

Mean of congruent task: 14.051125

Mean of incongruent task: 22.01591667

Point estimate of mean difference is $14.051125 - 22.01591667 = -7.9647917$

Sample size: 24

SD of differences: 4.86482691

t-statistic = $-7.9647917 / (SD / \sqrt{24}) = -8.021$

t-critical values are: -2.069 and 2.069 (95% confidence level with $DF=23$)

Since t-statistic falls under the critical area, which is considered significant, we reject the Null Hypothesis. We conclude that time it takes to name the ink color for congruent and incongruent words is significantly different. This matches up with my experience and 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!