Demerrick Moton
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Statistics: The Science of Decisions

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.

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

- Independent Variable: The colors, names, size, and condition of the list of words
- Dependent Variable: Time it takes to correctly name the ink color in equally-sized lists

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

I want to test whether words supersede colors in selective memory

H_0: $\mu_{congruent} < \mu_{incongruent}$

H_A: $\mu_{congruent} >= \mu_{incongruent}$

(One-Tailed Test)

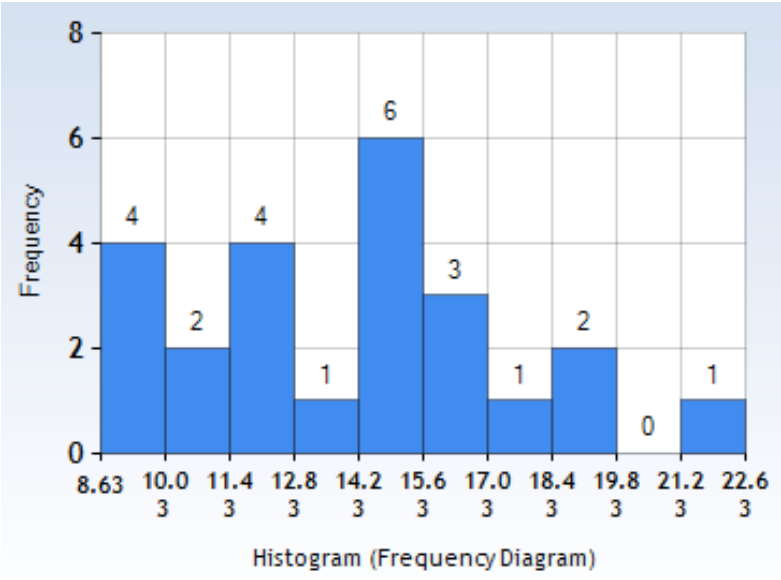
Hypothesis: Since the congruent set represents primarily the words being recognized, the mean for this should be higher than the mean for the incongruent set

Summary: To test the above hypothesis, I will perform a t-test on the given data set. The null hypothesis (H_0) tests whether the mean time that it takes to recognize a word/color for a sample is quicker than the time it takes to recognize just the color. This implies that the brain will recognize words associations faster than color associations. The alternative hypothesis (H_A) represents the cases that the null hypothesis does not cover – namely, that it will take more (or equal) time to recognize a list of words from the congruent word list. Since the alternative hypothesis covers cases greater than or equal to a target value, it will be a one-tailed test.

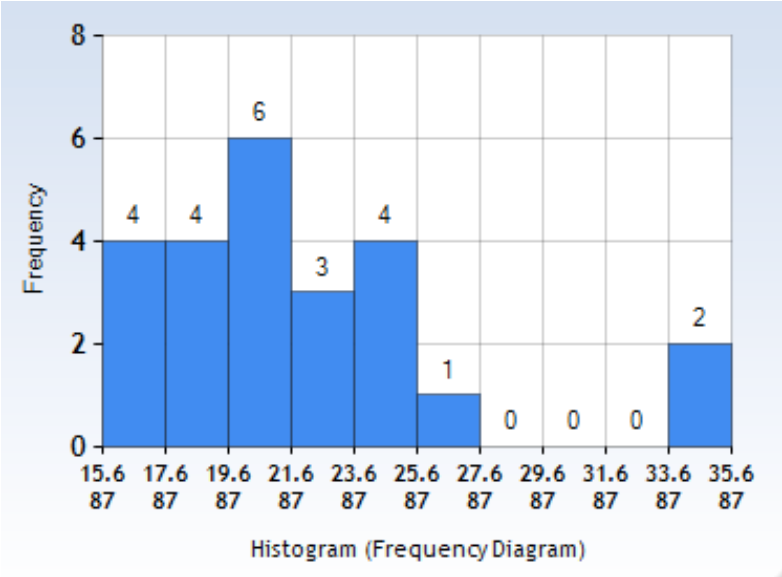
3. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.

Congruent	**Incongruent**
mean = 14.05	mean = 22.02
size = 24	size = 24
median = 14.35	median = 21.01
std. dev. = 4.00	std. dev. = 4.80
Q1 = 11.34	Q1 = 18.644
Q2 = 14.36	Q2 = 21.01
Q3 = 16.791	Q3 = 24.52

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.



Histogram of response time for congruent list



Histogram of response time for incongruent list

It's clear that the response time for the congruent list was faster and that response time settled around 14-17 seconds for the congruent list and 17-22 for the incongruent list. The point in the far right in the incongruent list might almost be considered outliers.

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?

t-Test Specification:
Do words supersede colors in selective memory?

H_0: $\mu_{congruent} < \mu_{incongruent}$

H_A: $\mu_{congruent} >= \mu_{incongruent}$

(One-Tailed Test)

t-Test for two dependent samples:
Confidence Level: 95% (α=.05)
Critical Value (df = 23): 1.714
D_bar = 7.96
SE: .382
t-Statistic: 20.84

20.84 >= 1.714 so H_0 is rejected
The difference between congruent and incongruent scores is statistically significant

The results matched my expectations – subjects recognized words faster (or more easily) than just colors. I think that the first test may have had a small effect on the second, which is why they were assumed to be dependent. That is, maybe some users got better at taking the test once, and it affected the score on their second time taking it, but I think that effect would not be too significant.

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!

I think the effect may be due to the fact that as we grow older, we interpret words more frequently than we interpret colors – maybe because words carry more information and are more useful. I think I've seen a similar experiment where police have to look at a series of photos of situations and determine which of the situations depict a non-threat, medium-threat, or high-threat. They unconsciously picked out certain things to pay attention to while ignoring other things. I think trying this test on illiterate (or low-reading level) adults might be interesting to see how different the results would be vs literate adults.