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

1. What is our independent variable? What is our dependent variable?
Independent variable is the two different conditions: a congruent words condition and an incongruent words condition. Dependent variable is the time it takes for each participant to finish their word lists from each condition

2. What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices.
We suppose the incongruent words condition will take more time for participant to finish the whole lists. So, we will suppose our null hypothesis will be there's no difference between congruent words and incongruent words. And alternative hypothesis will be incongruent words condition will take more time than congruent words condition. We will do a one dependent sample t-test, and also one tailed test on positive side. We suppose difference between two groups are u. Ud = time of incongruent group minus congruent group.
Null hypotheses Ho: Ud <= 0
Alternative hypotheses Ha: Ud > 0

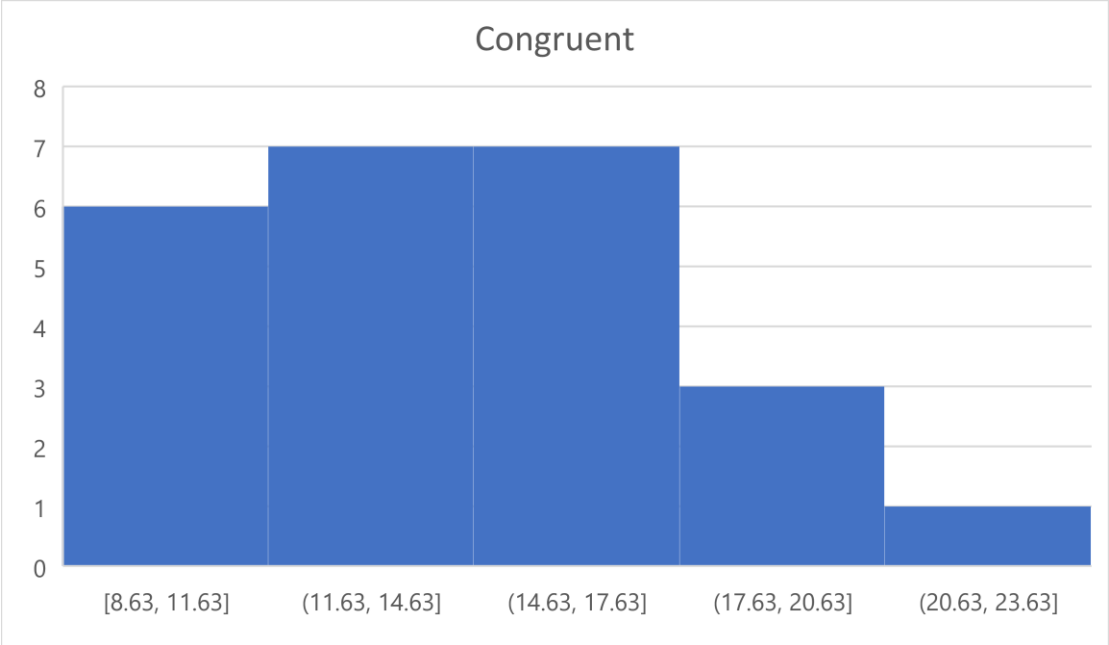
3. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.
Central tendency: mean for congruent= 14.05 mean for incongruent= 22.02
Median for congruent = 14.36 Median for incongruent= 22.12

Measure of variability: range for congruent=13.698 range for incongruent= 19.568
SD for congruent=3.56 SD for incongruent= 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.

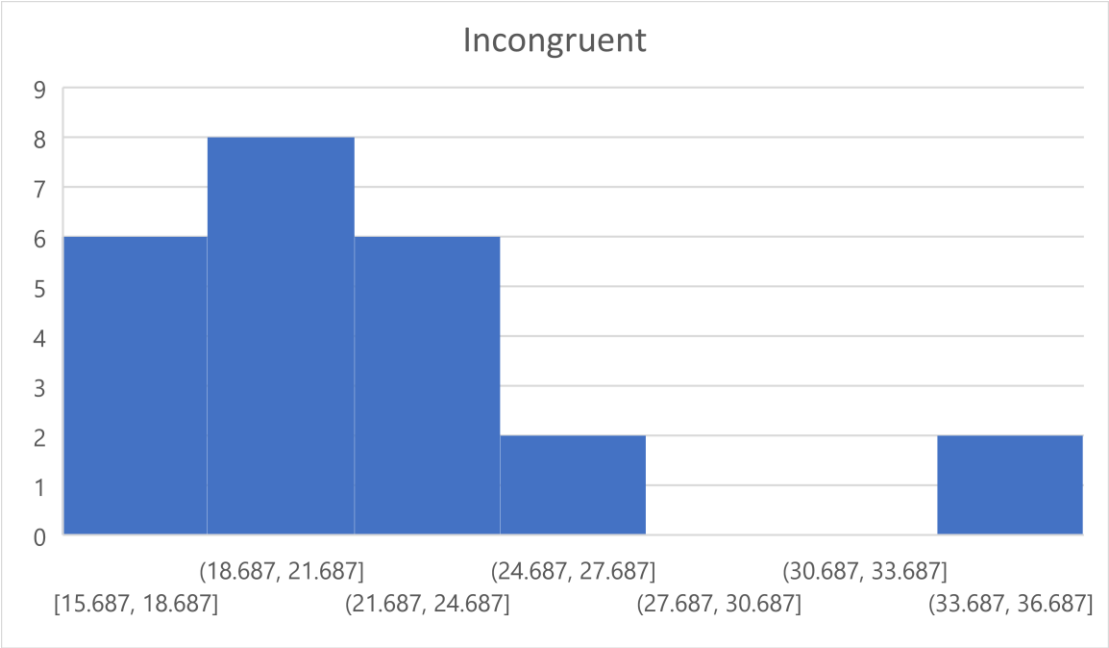
Congruent

Time range	Frequency
8-11	5
11-14	6
14-17	9
17-20	3
20-23	1



Incongruent

Time range	Frequency
15-18	5
18-21	7
21-24	6
24-27	4
27-30	0
30-33	1
33-36	1



It looks like both charts are positive skewed. Most people use 8-17 seconds to finish first test and 15-27 to finish second test.

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?

Congruent	Incongruent	Difference
12.079	19.278	7.199
16.791	18.741	1.95
9.564	21.214	11.65
8.63	15.687	7.057
14.669	22.803	8.134
12.238	20.878	8.64
14.692	24.572	9.88
8.987	17.394	8.407
9.401	20.762	11.361

14.48	26.282	11.802	
22.328	24.524	2.196	
15.298	18.644	3.346	
15.073	17.51	2.437	
16.929	20.33	3.401	
18.2	35.255	17.055	
12.13	22.158	10.028	
18.495	25.139	6.644	
10.639	20.429	9.79	
11.344	17.425	6.081	
12.369	34.288	21.919	
12.944	23.894	10.95	
14.233	17.96	3.727	
19.71	22.058	2.348	
16.004	21.157	5.153	
14.05113	22.01592	7.964792	<--mean for the each list
		4.864827	<--standard deviation for difference

Let's suppose a=0.05, DF=23, tcritical=1.714
SD for difference = 4.86 SEM=0.992 mean difference for two group=7.96
Tstastic=7.96/0.992=8.024 p value is less than 0.0001
95%CI=(6.26,9.66)
So we will reject the null hypothesis. It looks like incongruent word lists takes more time for participant to complete. The results match up our 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!
This experiment suggests that there's a lag in the brain's ability to recognize the color of the word. Because the brain reads words faster than it recognizes colors. The color recognition is opposed to reading a word. The brain needs to use more attention to recognize a color. The brain automatically understands the meaning of words as a result of habitual reading, but nor for recognizing colors.
Stroop task can also be used to study the relations between speed of processing and executive functions with working memory and cognitive development in various domains.

Reserch link: https://en.wikipedia.org/wiki/Stroop_effect