PROJECT: TEST A PERCEPTUAL PHENOMENON

Project Overview

In this project, you will investigate a classic phenomenon from experimental psychology called the Stroop Effect. You will learn a little bit about the experiment, create a hypothesis regarding the outcome of the task, then go through the task yourself. You will then look at some data collected from others who have performed the same task and will compute some statistics describing the results. Finally, you will interpret your results in terms of your hypotheses.

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?

A. Independent variables: *congruent words* condition, *incongruent words* condition
   Dependent variables: The time it takes to name the ink colors 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.

A. Null Hypothesis – H_0: $\mu_C = \mu_I$

   H_0 – The population mean of the congruent words (μ_C) equals the population mean of the incongruent words (μ_I).

   Alternative Hypothesis – H_A: $\mu_C \neq \mu_I$

   H_A – The population mean of the congruent words (μ_C) does not equal the population mean of the incongruent words (μ_I).

   Where, μ_C = mean of the congruent words population.
           μ_I = mean of the incongruent words population.

   Statistical Test: Dependent t-test (two tailed).
   Justification:
   - These are paired samples of the same subjects over two conditions.
   - We are assuming normal distribution for the two samples and their populations.
   - A t-test is appropriate when we are handling small samples (n < 30).

- We prefer a t-test over a z-test since the population parameters like standard deviation are unknown.
- We need to compare the means of two related groups to determine if there is a statistical significance.
- It is a two tailed test because our hypothesis is testing equality of two means.

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

Samples		Deviations from Mean		Squared Deviations	
Congruent	Incongruent	Congruent	Incongruent	Congruent	Incongruent
12.079	19.278	-1.972125	-2.737916667	3.889277016	7.496187674
16.791	18.741	2.739875	-3.274916667	7.506915016	10.72507917
9.564	21.214	-4.487125	-0.8019166667	20.13429077	0.6430703403
8.63	15.687	-5.421125	-6.328916667	29.38859627	40.05518617
14.669	22.803	0.617875	0.7870833333	0.3817695156	0.6195001736
12.238	20.878	-1.813125	-1.137916667	3.287422266	1.29485434
14.692	24.572	0.640875	2.556083333	0.4107207656	6.533562007
8.987	17.394	-5.064125	-4.621916667	25.64536202	21.36211367
9.401	20.762	-4.650125	-1.253916667	21.62366252	1.572307007
14.48	26.282	0.428875	4.266083333	0.1839337656	18.19946701
22.328	24.524	8.276875	2.508083333	68.50665977	6.290482007
15.298	18.644	1.246875	-3.371916667	1.554697266	11.36982201
15.073	17.51	1.021875	-4.505916667	1.044228516	20.30328501
16.929	20.33	2.877875	-1.685916667	8.282164516	2.842315007
18.2	35.255	4.148875	13.23908333	17.21316377	175.2733275
12.13	22.158	-1.921125	0.1420833333	3.690721266	0.02018767361
18.495	25.139	4.443875	3.123083333	19.74802502	9.753649507
10.639	20.429	-3.412125	-1.586916667	11.64259702	2.518304507
11.344	17.425	-2.707125	-4.590916667	7.328525766	21.07651584
12.369	34.288	-1.682125	12.27208333	2.829544516	150.6040293
12.944	23.894	-1.107125	1.878083333	1.225725766	3.527197007
14.233	17.96	0.181875	-4.055916667	0.03307851562	16.45046001
19.71	22.058	5.658875	0.04208333333	32.02286627	0.001771006944
16.004	21.157	1.952875	-0.8589166667	3.813720766	0.7377378403

Congruent Mean	14.051125	Incongruent Mean	22.01591667
Congruent Variance	12.66902907	Incongruent Variance	23.01175704
Congruent Std Deviation	3.559357958	Incongruent Std Deviation	4.797057122

Central tendency: Congruent mean = 14.0511
                 Incongruent mean = 22.0159
Measure of variability: Congruent sd = 3.5594
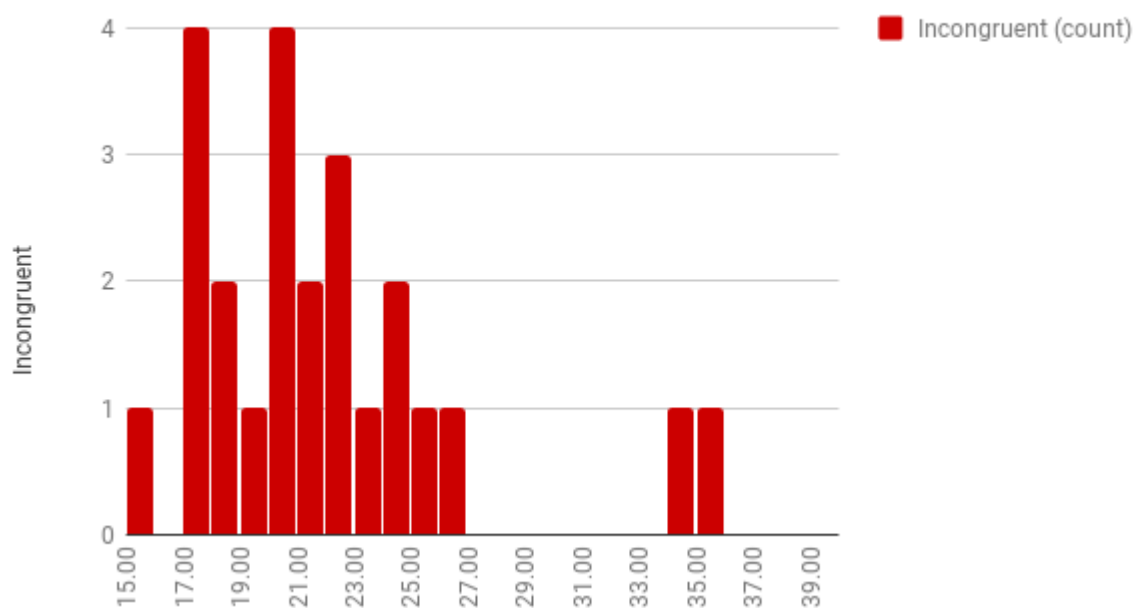   Incongruent sd = 4.7971

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.
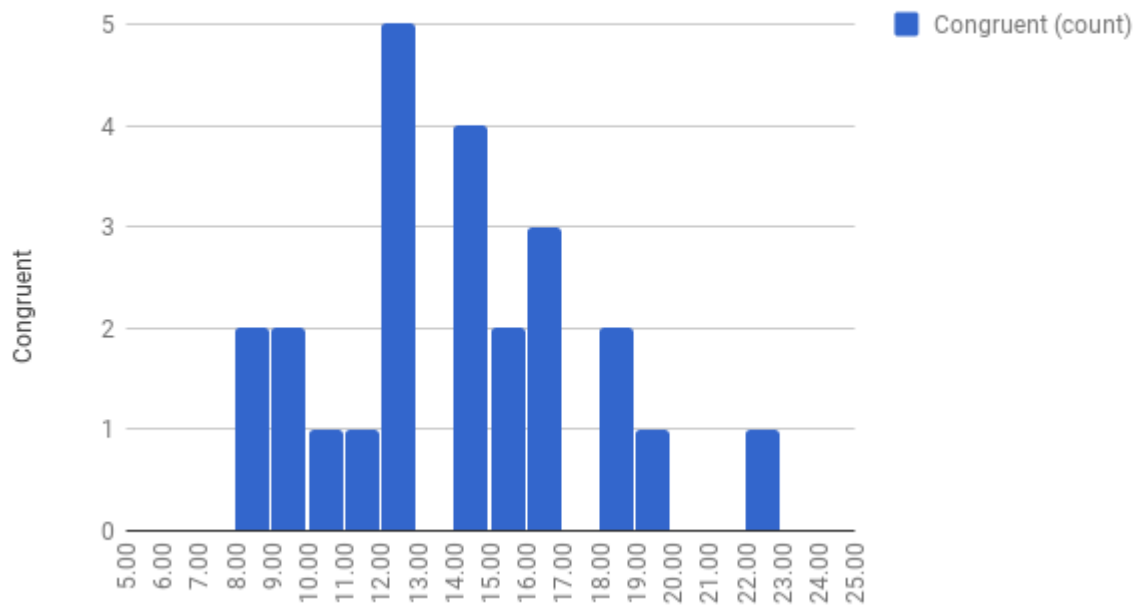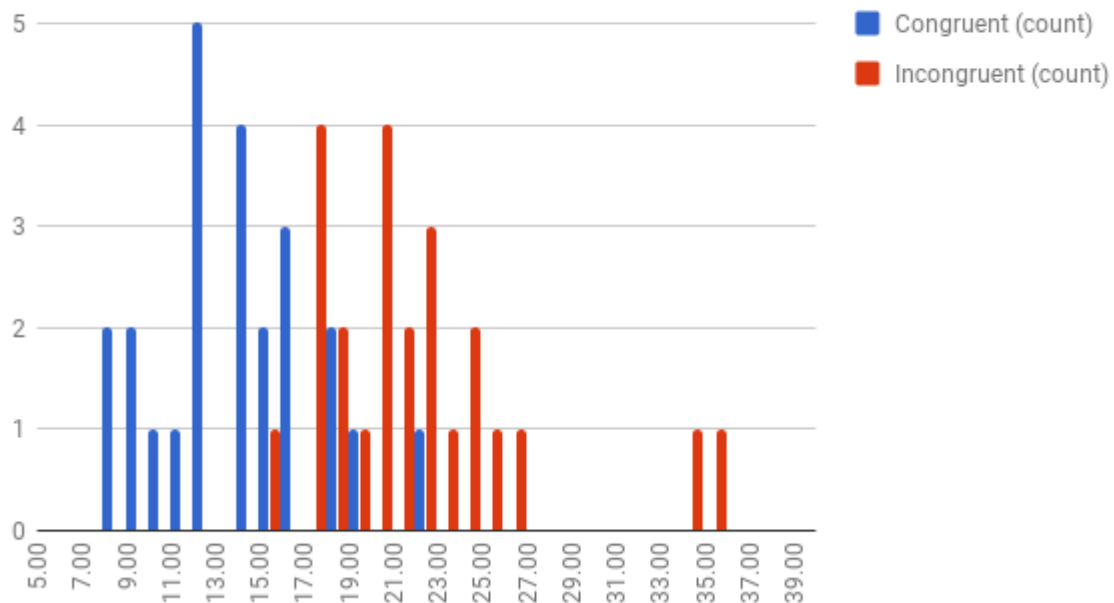

The congruent histogram appears to be a normal distribution.

The incongruent histogram appears to be a normal distribution but with two outliers.

Congruent and Incongruent Histogram

The combined histogram appears to be a normal distribution.

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?

A. The statistical results are given as below

Degrees of freedom	23
α	0.05
Point Estimate	-7.964791667
Stdev of difference	4.86482691
Standard Error	0.9930286348
t-statistic	-8.020706944
t-critical	2.069

Looking at the above stats, the t-statistic falls in the critical area.
The two-tailed P value is less than 0.0001 and by conventional criteria this difference is considered to be extremely statistically significant.
Hence, we reject our Null Hypothesis and conclude that congruent and incongruent groups have different average population time to complete tasks.

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!

A. There are several theories used to explain the Stroop effect and are commonly known as

'race models'. This is based on the underlying notion that both relevant and irrelevant information are processed in parallel, but "race" to enter the single central processor during response selection. They are:
Processing speed
Selective attention
Automaticity
Parallel distributed processing
For a more detailed explanation on these race models refer to the reference section.

The warped words Stroop effect produces the same findings similar to the original Stroop effect. Much like the Stroop task, the printed word's color is different from the ink color of the word; however, the words are printed in such a way that it is more difficult to read (typically curved-shaped).[36] The idea here is the way the words are printed slows down both the brain's reaction and processing time, making it harder to complete the task.

Reference

Stroop Effect - Theories
Variations - Warped Words
P-value – Graph Pad