Statistics: The Science of Decisions

Stroop Task Experiment

Independent Variable

The independent variable are the task conditions – congruent or incongruent.

Dependent Variable

The dependent variable is the time taken to complete a task condition.

Hypothesis

Let μ_C represent the mean of Congruent tasks
Let μ_I represent the mean of Incongruent tasks
Let μ_D represent the mean of Differences of Incongruent to Congruent tasks

$\mu_D = \mu_I - \mu_C$

H_o: $\mu_D <= 0$
H_a: $\mu_D > 0$

I expect to perform an one Sample t-test for dependent means. We assume the sampled data is from a defined population, and scores are normally distributed in the population. Since each user is taking first the congruent and then incongruent task this suggests dependency between data sets. We do not have the full population data and therefore cannot perform a z-test.

The H_o predicts there will be no difference in average task times, or that the average incongruent task time will be less than the average congruent task time . H_a predicts the opposite, and that the average incongruent task time will be greater than the average congruent task time.

Therefore the t-test will be a one tailed test with α level 0.05 in the positive direction.

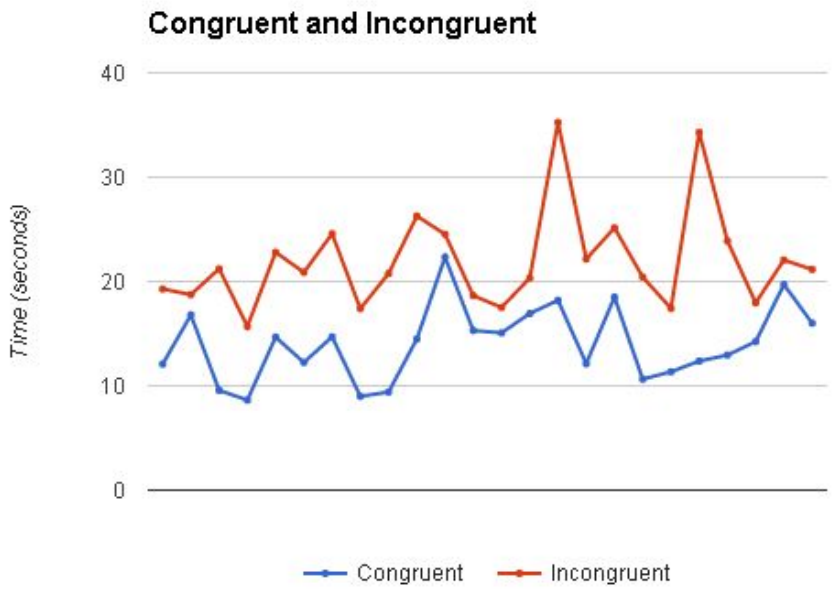
My Stroop Task Times (seconds)

Congruent: 19.384
Incongruent: 32.085

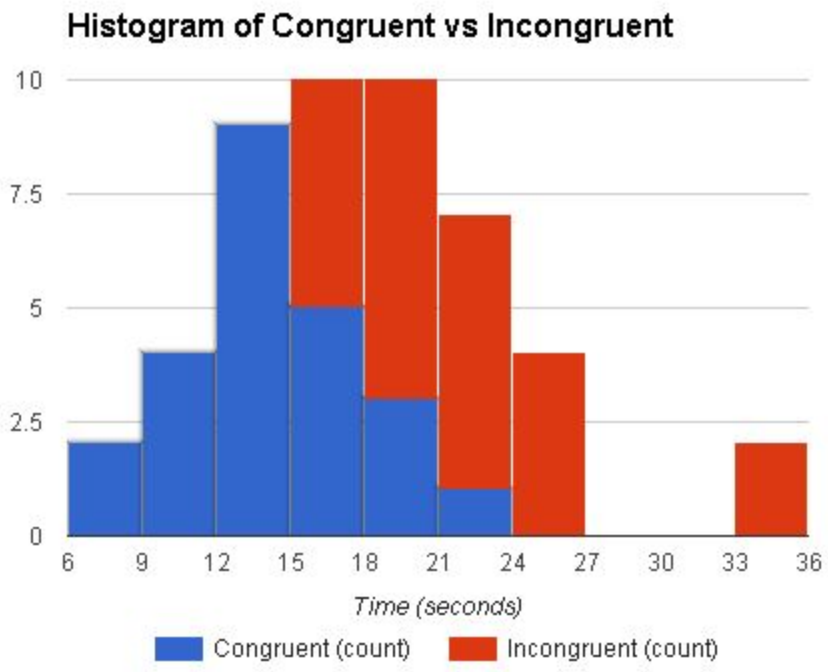
Statistics

Statistic	Congruent	Incongruent
N (sample size)	24	24
Mean (μ)	14.051125	22.01591667
Median	14.3565	21.0175
Variance	12.14115286	22.05293383
Standard Deviation	3.559357958	4.797057122

Visualizations



This line graph demonstrates that the incongruent times are always longer for each individual in the sample. However, some individuals are able to complete the incongruent task faster than others congruent task.



We can see from the histograms that the Congruent task is a normal distribution. The majority of entries are in the 12-15 bin, where it's mean is above at approx 14.05. The remaining values fall around it in almost equal proportion. The Incongruent histogram and mean suggests a positively skewed distribution starting from 15-18 seconds while the mean is calculated further out at 22.01

Statistical Test

Statistic	**Value**
df	23
α	0.05
T-critical (one tailed)	1.6787
T-critical (two tailed) for CI calculation	2.069
X_d (sample mean difference)	7.964791667
Standard Deviation	4.86482691

Standard Error	0.9930286348
Margin of Error	2.054576245
t-score	8.020706944
Cohens d	1.637219949
r^2	0.7366364161

t(23) = 8.02, p < 0.0001, one- tailed
Confidence Level on the Mean Difference, 95%, (5.91, 10.02)

Effect Size Measures

d=1.63
r^2=0.74

Conclusions

The data is statistically significant and we can reject the H_o.

The r^2 suggests the stroop task accounts for 74% of time difference between tasks (congruent and incongruent).

I expected the incongruent task to take a longer time - especially after taking the test myself. I didn't expect the time difference gap to be as wide as suggested. After reading the Theories section on the wiki on the stroop effect (https://en.wikipedia.org/wiki/Stroop_effect) I feel that Automaticity makes the most sense to me. I personally find it's extremely difficult to ignore written word and required much more concentration and active focus to determine the color blocks during the test.

A similar test may be using shapes and words, where in test 1 the shape has the name of the shape within it. In test 2 the shape has a different named shape within it.

Used to determine p-value
http://www.graphpad.com/quickcalcs/pValue2/

To help understand the results
https://en.wikipedia.org/wiki/Stroop_effect