

# Proj2 - Statistics of Stroop Task

Author: Xiao Liu

Created: 08/10/2017

LatestModify: 08/11/2017

## 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(red), BLUE(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(green), ORANGE(purple). 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.

## Investigation

### Type of data

Dependent t-test for two conditions paired samples

### What is independent variable?

The independent variable is whether the words shown are **congruent** with the ink colors or if they are **incongruent** with ink colors.

### What is dependent variable?

The dependent variable is the amount of time it takes to name, out loud, the color of the inks in which the words are displayed.

### Test hypothesis -- null hypothesis

$\mu_c$  is the sample mean of the time spent naming the words in congruent test

$$\mu = \frac{\sum x_i}{n}$$

$\mu_i$  is the sample mean of the time spent naming the words in incongruent test

Null hypothesis: the time used to reading list of incongruent words has no obvious longer than reading congruent words list

$$H_0 : \mu_c \geq \mu_i$$

### Test hypothesis -- alternative typothesis

Alternative hypothesis: the time used to read list of incongruent words will be larger than the time in congruent words list

$$H_A : \mu_c < \mu_i$$

### t-test

Since z-test works when we know population  $\mu$  and  $\sigma$ . In this case, we have less than 30 samples, and we don't know the population's standard deviation. We will use t-test.

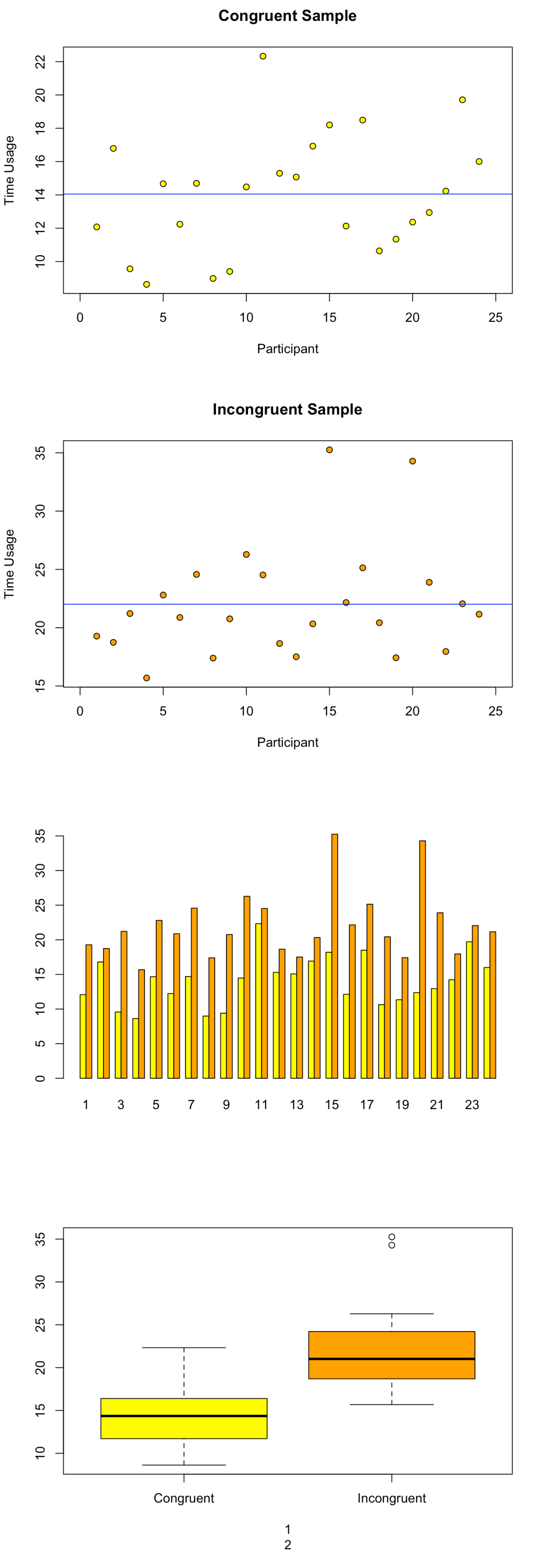
We should assume that the distributions are Gaussian.

Based on the alternative hypothesis, t-test will be one-tailed test in positive direction

Find the t-critical values for a one-tailed test at  $\alpha = 0.05$ :

$$t_{critical} = 1.714$$

### Data at a glance



### Statistics tests

$$n = 24$$

$$df = n - 1 = 23$$

$$\mu_c = 14.05; \sigma_c = 3.56$$

$$\mu_i = 22.02; \sigma_i = 4.80$$

mean of difference between two conditions:

$$M_D = 7.96$$

standard deviation of difference:

$$S_D = \sqrt{\frac{\sum (D_i - \bar{D})^2}{n-1}} = 4.86$$

standard error of mean:

$$SEM = \frac{S_D}{\sqrt{n}} = 0.99$$

t-statistic:

$$t_{statistic} = \frac{M_D}{SEM} = 8.04$$

95% confident interval for the mean difference:

$$CI : M_D \pm t_{critical} \times (SEM) = (6.27, 9.65)$$

### Desisions

Based on the t-statistic and t-critical value:

- The results are statistically significant
- Reject the null** because  $p < 0.05$
- The time used to read list of incongruent words will be larger than the time in congruent words list
- The result matches expectations because the incongruent task is much harder than congruent words. It takes longer time.

### Optional:

Cohen's d:

$$Cohen's\ d = \frac{M_D}{S_D} = 1.64$$

Proportion(%) of variability in longer time due to incongruent words list:

$$r^2 = \frac{t^2}{t^2 + df} = 0.74$$

According to effect size measures, it is responsible for the effect observed.

Color stroop test can have many variations, such as warped words, emotional, spatial, numerical, etc. They all keep the same people do a normal test, and do a harder varianced test. The data sample should be similar effects.