Background

The Stroop task is a well-known psycholinguistic experiment. Participants are given a list of color names to read that are printed in various colors. In the first task, the colors and color names match. This is called the congruent condition. In the next trial, the colors and color names are not matched; this is called the incongruent condition. For both conditions, the amount of time taken is measured.

In this analysis I am analyzing a dataset comprised of the results for 24 individuals over both conditions.

Questions

1. The independent variable in this experiment represents the test condition that is being manipulated. In this case the independent variable is which of the two conditions we are giving the participants.
   The dependent variable is the variable that changes as a result of a change to the independent variable. In this case the dependent variable is the amount of time it takes for a participant to complete the Stroop task.

2. The null hypothesis is that there is no significant difference between the time taken in the congruent and incongruent conditions at an alpha of .05. The alternative hypothesis is that the incongruent condition will differ significantly by being greater than the congruent condition with alpha .05.

   Null→ $H_0: \mu_{congruent} \geq \mu_{incongruent}$
   Alternative→$H_{A:} \mu_{congruent} < \mu_{incongruent}$

   We are working with a sample size of only 24 individuals. We do not know the mean or standard deviation of the population this sample came from. This means that a t-test is better than a z-test. Since I the two conditions of the Stroop task are related, I am testing to see whether the means of the differences are significant compared to a target value. This means I should use a paired t-test.
   Since I am testing for a specific direction, I will be using a one-tailed t-test to confirm or reject my null hypothesis. Since the independent variable is expected to be greater than the dependent variable I will be performing a one-tailed t-test in the positive direction.
   All together, I will be performing a positive, one-tailed, paired t-test.

3. The mean of the congruent group is 14.051 while the mean of the incongruent group is 22.0159. The sample standard deviation of the congruent group is 3.559 while the sample standard deviation of the incongruent group is 4.797.

4. As we can see in the following visualization, there is a definite relationship between the two variables. The congruent time is always lower than the incongruent time. This graphic somewhat flattens the line since the axes have different start and end values. If anything, this relationship is more robust than shown.
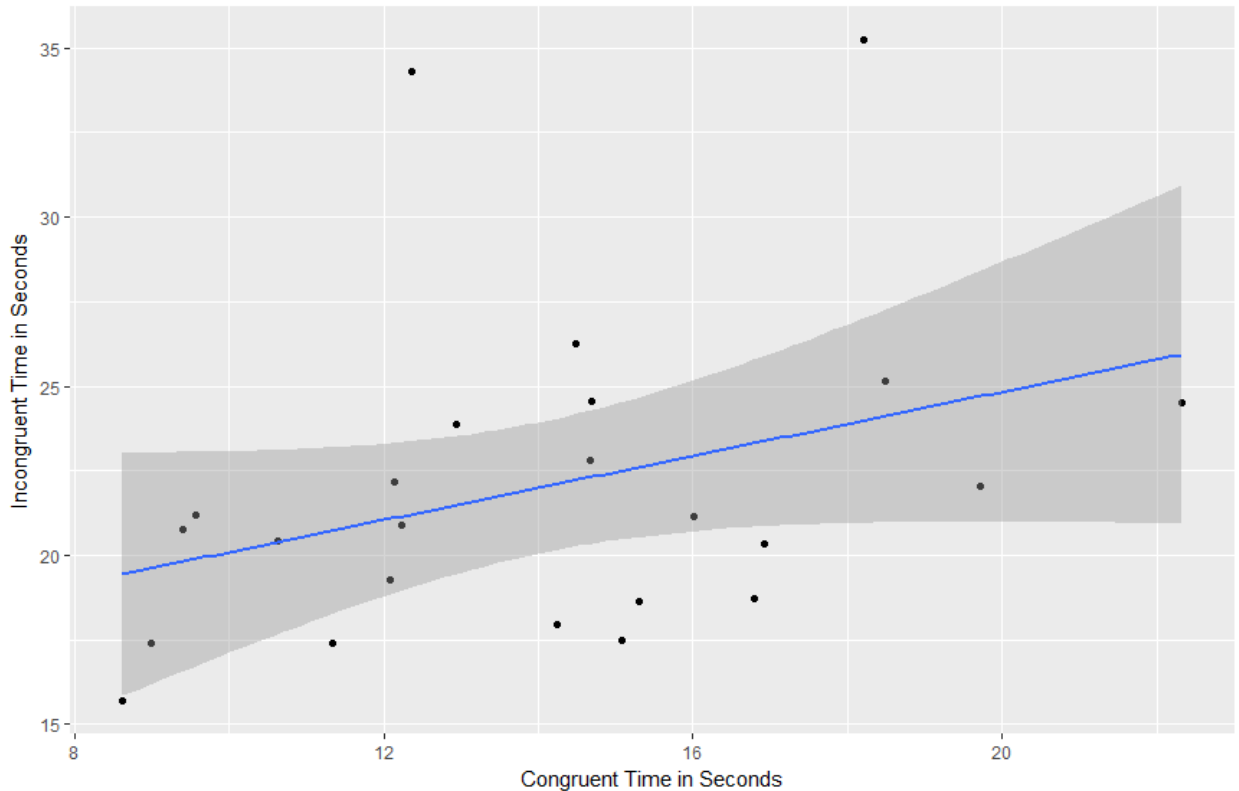
5. Now that I have my null and alternative hypotheses and a sense of the distribution of the data, I can do a statistical test.
My alpha level is .05 with 23 degrees of freedom; this makes my t-critical value 1.714. The standard deviation of the differences is 4.865 so the standard error of the mean is .993.
The difference of the means is 7.965 so I can divide that by the SEM to get a t-statistic of 8.021.

Our t-statistic is larger than our t-critical value. This means we can reject the null hypothesis with p<.05. This means that it is unlikely that the difference between the two conditions is due to chance alone.

6. In the first condition, the color name and text color were mutually reinforcing while in the second task they interfered with each other. We would expect the subject to take slightly longer because they are processing more information and taking longer to decide what is relevant.