P1: Statistics

This exercise is about describing and analyzing a set of data about the Stroop test. In this test, participants are introduced to a list words of colors such as, 'BLUE', 'YELLOW', 'GREEN'. These words are colored in two ways. In one way, the meaning of the word has the same color, e.g: 'BLUE' is colored as blue. The other way is tricker, the color of the word is different from the meaning, e.g: 'BLUE' can be colored as red or yellow. Let's call the sets Normal and Anormal, for the sake of simplicity.

The first part of the experiment is conducted with the Normal set. The participants are presented to one word of this set and their reaction time to identify the word is measured. Then, words of the second set are introduced in the same way. So, the Stroop test consists in measuring the participants reaction time for each set of words.

In this exercise, I will try to measure if there is a significant difference in the reaction time between those set of words. To do that, I will use the data set provided by Udacity that contains the results of participants of the Stroop test.

Comparison between Normal and Anormal sets

The dependent variable is the colored word that appears on the screen. The independent is the reaction time.

Let's say that the sample mean is denoted by μ, the standard deviation being σ. The underscore will denote if it is related to anormal or normal sets. The sample means would be for anormal and normal is μ_A and μ_N, respectively.

The T-test seems to be the right choice to compare the data available. It performs a statistical comparison of small samples (n ¡ 30) using the Student's T-distributions and uses no information about the population. That is the case since the sample size available is 24 and there is no information about the population. I expect the anormal test to be more difficult, thus the one right tailored t-test is a good hypothesis framework.

M1 Hypothesis

H_0: $\mu_A - \mu_N = 0$

H_a: $\mu_A > \mu_N$

The goal of this test is to show if the change on the colors of the words affect the response time to identify it. In order to accomplish that the same group of people was timed with Normal and Anormal words. The results can be seen in figure 1. This plot shows that the Anormal sample has a consistent larger response time than the Normal sample, which indicates that the null hypothesis might be rejected.

The Normal mean response time, $\mu_N = 14.05$ seconds, with a standard deviation, $\sigma_N = 3.55$ seconds. On the other hand, the anormal mean response time, $\mu_A = 22.02$ seconds, with a standard deviation, $\sigma_A = 4.79$ seconds. Just these values show that the response time increased substantially when the colors of the words did not match with the meaning of the word. To be sure of the impact on the response time, I will perform a one right tailed t-test with an alpha level, $\alpha = 0.05$.

Well, the t critical value for $\alpha = 0.05$ for a one tailed test is $t_{crit} = 1.71$. The $t_{value}$is calculated by the formula,

$$t_{value} = \frac{\mu_N - \mu_A}{S_D/\sqrt{n}}, \tag{1}$$

where n is the sample size, 24 in this case; and S_D is the standard deviation of the differences, $S_D = \sqrt{\sigma_N^2 + \sigma_A^2}$.

This gives $t_{value} = 6.39$, which is way bigger than the $t_{crit} = 1.71$. Thus, the **Null Hypothesis (H_0) can be rejected**. The probability of this result to happen by chance is p = 1.1e−6, which is very small.

Therefore, I can conclude that Anormal set really delays the response time to identify a word. I was expecting this result because it seems more difficult to my brain to sort out two correlated informations at the same time, the word meaning and the word color. Since I have more trouble to do that, I expected that people would have the same problem by inference.

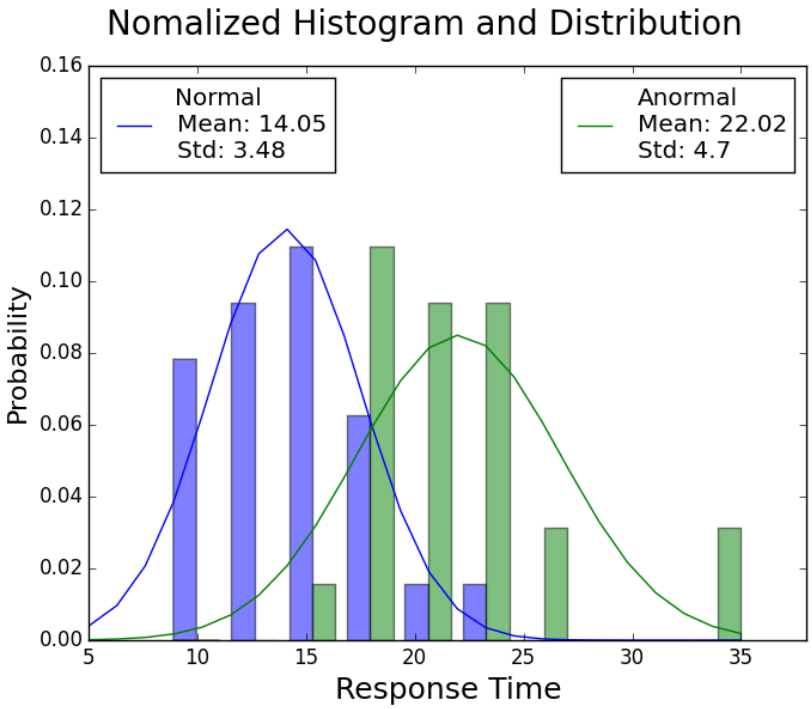

Figure 1: Normalized Histogram and Probability Density Distribution for Normal (blue) and Anormal (green) time tests for a sample size of 24. The y axis represents the sum of response time to identify a word.