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NE328
Lab 2: Sternberg Analysis

Introduction:
Saul Sternberg created a method of measuring reaction time called the additive factors method, in which he divided reaction times into multiple stages. These stages were the sensory, comparison and response stage. The intensity of the stimulus takes place during the sensory stage (Posner). The comparison stage, depends on the number of items required to be processed and the response stage is usually a motor output. The Sternberg experiment involved showing a subject a list of numbers, then showing them a single number from the list to if the subject recognized that number. Many factors can play into how someone performed during this experiment, such as alertness, attention and memory (Sternberg). After performing this experiment with 20 subjects from our class, we decided to test some of these parameters on the dataset.

Hypothesis:
Studies show that coffee increases focus and reaction time, so this gives us reason to believe that number recognition time would display positive correlation with increased coffee intake (Museum). We also believe that people who responded quickly would have a lower percentage correct, because they may have been rushing their responses, as opposed to people who took their time to make sure responses were correct. This effect is due to the speed-accuracy tradeoff (Sternberg). Lastly, familiarity with math and numerical organization could definitely play a valuable role in people's ability to quickly store and recall numbers, so we expect an increase in percentage correct and in reaction time.

The independent variables we used to compare against mean reaction times were:
Coffee Drinkers: 0, 1, 2, 3, 4, 5 or 6.
Percentage correct: 86%-96%
Level of Math Taken: High School Calc (1), Stats (2), Calc 1 (3), Calc 2 (4), and Multivariable Calculus or higher (5).

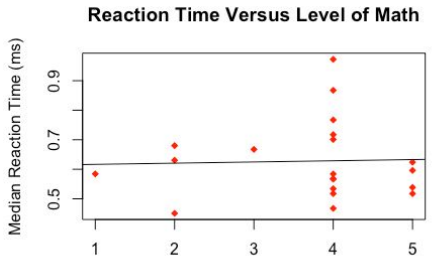
Methods:
Overview:
We utilized R-Studio along with the graphical integrator PsychoPy to test 20 subjects. Each experiment contained 137 trials. For each trial subjects were shown a series of numbers, the series disappeared, subjects were then presented with a number and asked to answer if the original series contains that new number. For each subject we also determined their weekly

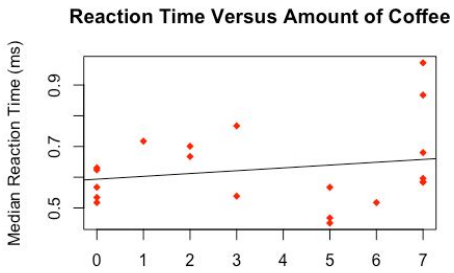
coffee consumption as well as the highest level of math they had taken. Finally we calculated the percentage of correct responses for each subject.

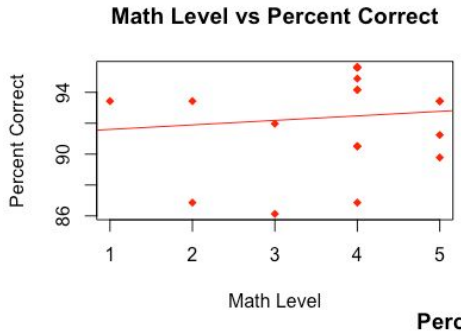
Details:

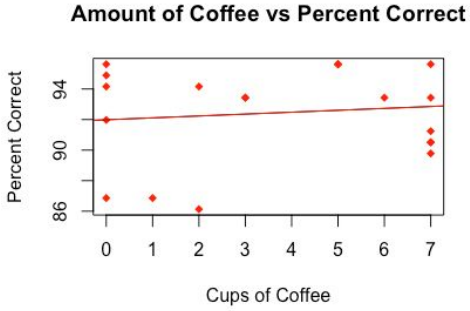
Once all data had been collected we used R-Studio to calculate the median reaction time for each subject. We compared this median reaction time to each subject's coffee consumption and math level, respectively. We used R-Studio to then graph the relationship between coffee consumption and reaction time, the relationship between math level and reaction time, the relationship between percentage correct and coffee consumption, and finally the relationship between percentage correct and math level. We then performed a linear regression on each graphed relationship. We then used R-Studio to construct a histogram of the percentage correct. We created boxplots for distributions of reaction times and correct responses, respectively. Lastly, we created ecdf's for coffee drinkers, percentage correct, and median reaction times to analyze the spread of the distribution.

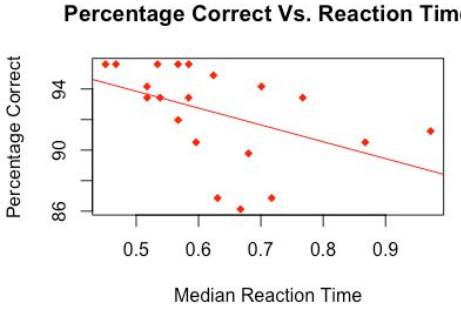
Results & Analysis:

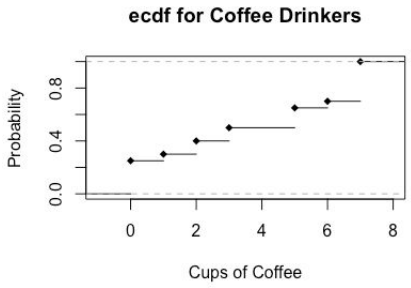


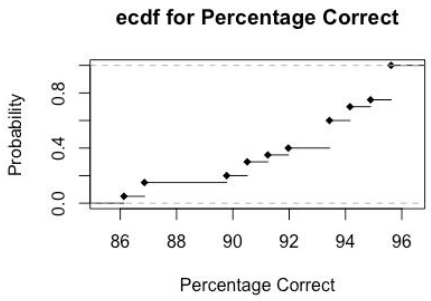


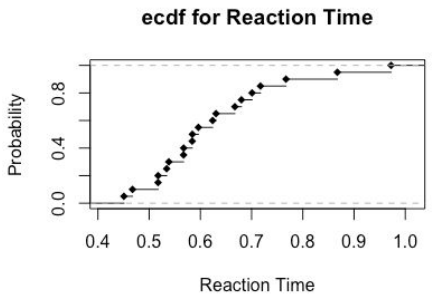


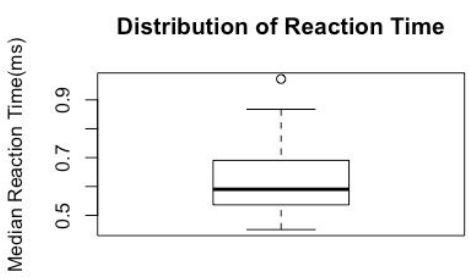


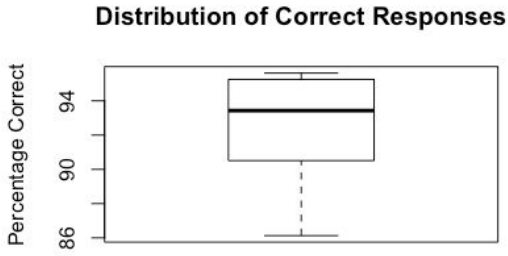


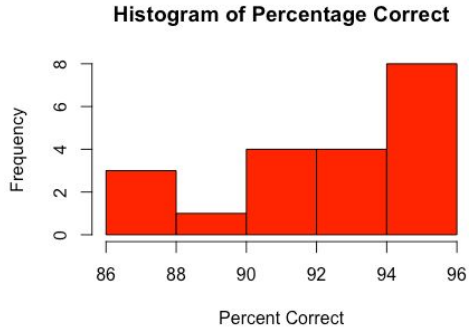












The Median Reaction Time data appears to be slightly right-skewed with a median near .6 with one outlier near 1 second. In contrast, the percentage correct data was strongly left-skewed with a median at 93 and no outliers. When comparing these two sets of data against each other, we found negative correlation between median reaction times and percentage correct with an R-squared value of .2131, and a p-value of .04, so we can say that our data is significant that we reject the null hypothesis. Our results for cups of coffee versus reaction time, however, had an extremely low R-squared value of .004 and a high p-value, reflecting low confidence.

Comparing reaction time to level of math our data revealed no correlation. We plotted a linear regression between the two variables which resulted in a line with an intercept of .6124 and a slope of almost 0. Examining the relationship between math level and percentage correct, we calculated the p-value to be .5896 which is far too little confidence to reject the null hypothesis. In terms of just correct responses, ~96% correct was the most frequent result with 8 subjects attaining said score. The ecdf's show the probability for amount of coffee consumed, the percentage correct, and the median reaction time. For cups of coffee the most probable response was 7 cups. For percentage correct the most probable result was 96%. For median reaction time the most probable response was .95 ms.

Conclusion:

One of the strongest conclusions we can draw from our data is that people who had quicker reaction times, also seemed to perform better overall, contrary to our original hypothesis. We expected a tradeoff between reaction time and percentage correct, but instead of observing the speed-accuracy tradeoff, we saw the opposite trend occur. In terms of level of math versus reaction time, no definitive conclusion could be drawn. This is because the linear regression model had a slope of almost 0. In regards to the relationship between amount of coffee consumed and median reaction time, subjects who drank more coffee in general had slower reaction times. The linear regression model calculated a p-value of .391 which indicates we can't reject the null hypothesis.

There may be other factors affecting our results that we didn't consider in this specific study, such as hours of sleep the subject got the previous night, which could affect alertness and attention during the study. Another factor that we could not control but was definitely present was the motivation by which the subject completed the study. All of the students knew that this was a relaxed environment with low stakes, but if there was a monetary incentive or an impact on the students grade, this could affect the status of the stimulus stage, ultimately affecting the motor output. Sternberg's insight into reaction time study helped propel our understanding of the functionality of many systems in our body.

Works Cited:

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