Caffeine and Memory

A brief analysis

Warren Atkison

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Introduction

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- I conjecture there is an association between people who drank caffeine before a memory test and people who improved on a memory test.

Data Collection

First, 80 people were randomly selected from the Island of Puama between the ages of 20 - 50 and given a DMA test. The next day, participants where split into two groups using random assignment. One group drank 250ml of caffeinated coffee before taking the DMA test again, and the other group drank 250ml of decaf coffee.

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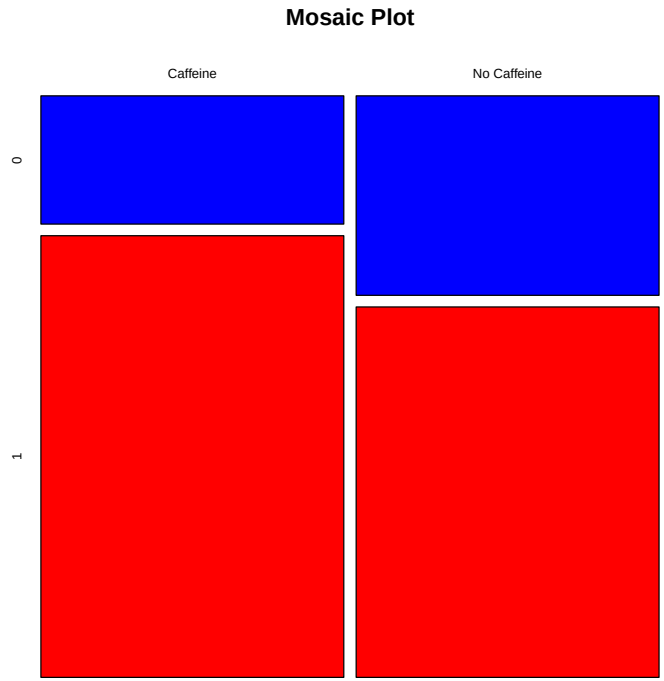
- Explanatory variable: Whether a person had caffeine or not for the post treatment test (categorical)
- Response variable: Whether or not a person improved from the base-line to post-treatment test (categorical)
- It was difficult obtaining consent for 80 Islanders, and getting a wide age range.

Descriptive Statistics

In the control group (no caffeine), 26/40 people improved their scores and in the treatment group (caffeine) 31/40 people improved their scores. This gives as a sample difference proportion of 0.125.



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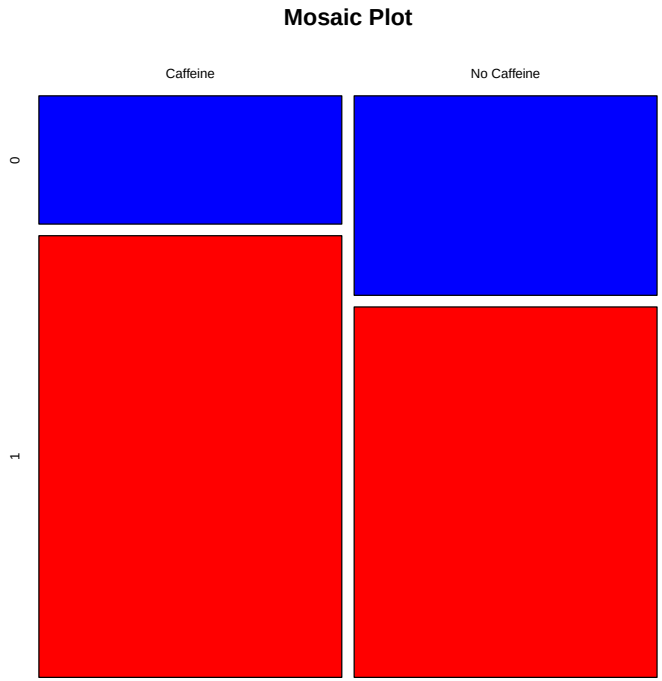

There appears to be a minor or no association.

Analysis of Results

Null and alternative hypotheses.

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Since we used random sampling and random assignment, our measurements are a representative sample of people from the town of Pauma.

Theory Based Approach

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- z-score: $z = 1.235$
- One sided p-value: $p = 0.107$

Assuming the null hypotheses, there is a 0.107 probability of achieving this statistic which is greater than 0.05, so we fail to reject the null. We have no evidence that drinking caffeine leads to an improvement in short term memory.

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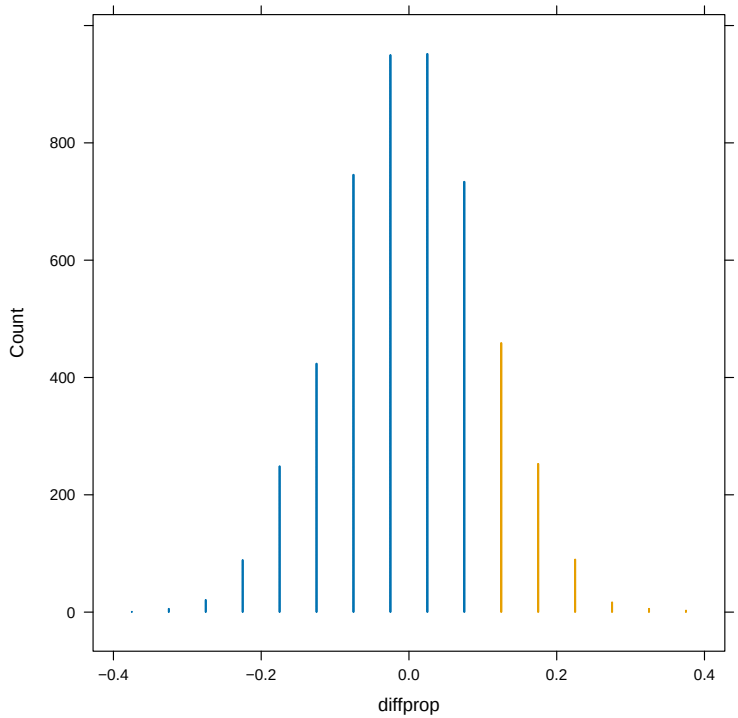

The mean is 0.001. With our statistic of $31/40 - 26/40 = 0.125$, and a standard deviation 0.102, we have a z-score of $z = 0.125/0.102 = 1.225$

Simulation Based Approach Cont.

With a z-score of 1.225, we have a p-value of 0.110. This is very similar to our theory based approach despite the validity conditions not being met. To find a 95% confidence interval, we take

$$(\hat{p}_t - \hat{p}_c) \pm \sigma = 0.125 \pm 0.102$$

Giving us a confidence interval of $[-0.079, 0.329]$.

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Giving us a confidence interval of $[-0.079, 0.329]$.

- We are 95% confidant that our parameter for the difference of proportions from the treatment and control is within the interval $[-0.079, 0.329]$. Since this interval contains 0, we fail to reject the null.

Discussion and Critique

We have no evidence that taking caffeine before a memory test is associated with improvement in that memory test, since in out simulated analysis we had a 0.110 probability of producing our statistic assuming there is no association which is not statistically significant.

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Next I would collect a bigger and more representative sample size. A further study could collect a quantitative response variable to measure memory for more in depth analysis.