Comparing Test Scores Between Boys and Girls

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Introduction

We are interested to see the difference mean score on some test scores between boys and girls. Do girls naturally do better in some subjects than men? Do mean do better in other subjects than girls? We aim to answer this question. This analysis is helpful because it can help teachers better understand who could be predisposed to struggle more in the class. Furthermore this can help universities and educators to understand effects of different teaching methods and give a better base line for expected performance. The American Psychology association has published an analysis claiming that girls do better than boys in school in essentially all subjects, we will be testing the validity of that claim.

Methods

Getting our Likelihood and Priors

The relevant parameters for our likelihood that we chose would be from a normal distribution. Since we believe that grades on a test will behave in a distribution that is likely to look more normal where most students will do generally well and only a few will get really high scores and a few will get very low scores. This will be useful in answering our question because we know that for most students this will generally be the pattern. For our prior distribution we decided that our priors for both boys and girls will be the same. However we still need two priors, one for the mean and one for the standard deviation of our likelihood.

$$\text{Likelihood} = \text{N} \sim (\mu, \sigma^2)$$

For the mean we chose a normal prior with $\mu = 80$ because we believe that most students will average around 80. We chose $\sigma^2 = 5$ because we believe that our guess about the mean being 80 might be off by around 5 points.

$$\mu = \text{N} \sim (80, 5^2)$$

For the standard deviation we chose an inverse gamma prior. In order to find what our a and b values would be we chose what we expected the value of σ^2 would be for our likelihood and what we thought the standard deviation of that would be. In our case we chose the mean and standard deviation to be 10 and 4 respectively. Then using method of moments we took those values and calculated a and b. From our results we got that $a = 3.6$ and $b = 256.3$.

$$\sigma^2 = \text{IG} \sim (3.6, 256.3)$$