PURDUE UNIVERSITY FORT WAYNE

Linear Regression of Brain Symmetry

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Abstract

Here I will examine how schizophrenia relates to the symmetry of the brain. Initial examination of the histograms suggests they could be different enough to be related. I will also examine the way gender plays in as a secondary possible factor, though I acknowledge that the small sample size of women might not offer a full picture of the overall population of women.

Keywords: schizophrenia, linear regression, brain symmetry

Introduction

The data used for this project comes from the *library(shapes)* package under *data(cortical)* It contains the vectors of measurements along the brain from $n = 68$ individuals, as well as the age, sex, brain symmetry, and whether or not each individual has been diagnosed with Schizophrenia. 54 of the 68 individuals are men; 14 are women. 38 of the individuals do not have a schizophrenia diagnosis; 30 have the diagnosis.

Materials & Methods

Information about the Data in this Experiment:

- When viewing the histograms of the data, we can see that they follow a normal curve
- we can look at the Quantile-Quantile (QQ) plots and see the data falls along the line [1]
- schizophrenic brains do seem to be skewed to the right, while healthy brains have a more even distribution, possibly due to what looks to be an outlier point on the far right

The following equations were used for statistical analysis:

$$\frac{\beta G^* - 0}{se(b)} \tag{1}$$

$$\frac{\beta G_2^* - \beta G_1^*}{se(b_2)} \tag{2}$$

$$\frac{p(n_1 + n_2 - 2)}{n_1 + n_2 - p - 1} \frac{\beta G_3^* - \beta G_4^*}{se(g_3)} \tag{3}$$

$$\mathbf{b} = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}\mathbf{y} \tag{4}$$

Analysis

The calculations yielded the following:

- t-ratio: $1.8908 < t_{66,.025}$:1.996564 - Accept Null; there is at least a 5% BG1 could = 0; schizophrenia does not play a significant role in determining brain symmetry
- t-ratio: $2.2341 > t_{66,.025}$:1.996564 - Reject Null; we can be 95% certain that, when including the variable sex, BG2 $\neq 0$ and it is a significant variable. It does effect symmetry
- t-ratio: $0.2539796 < t_{66,.025}$:1.996564 - Accept Null: There is at least a 5% chance that the coefficients BG1 and BG2 could be equal.
- t-ratio: $1.97011 < t_{52,.025}$ 2.006647 - Accept Null: There is at least a 5% chance that the coefficient BG3 could be 0.
- t-ratio: $1.12822 < t_{12,.025}$ 2.178813 - Accept Null: There is at least a 5% chance that the coefficient BG4 could be 0.
- f ratio: $1.25692 < f_{2,65,..025}$:3.906381 Accept Null; there is at least a 5% chance that BG3 and BG4 (the coefficients associated with schizophrenia) in men and woman could be equal.

Evidence of Normality

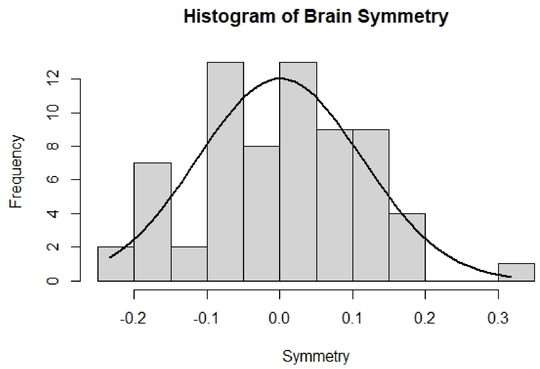

Figure 1: Histogram of Brain Symmetry

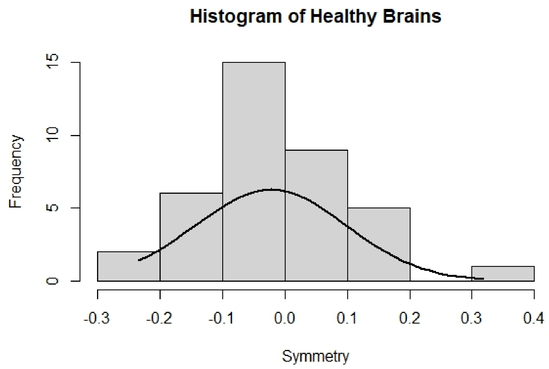

Figure 3: Histogram of Healthy Brains

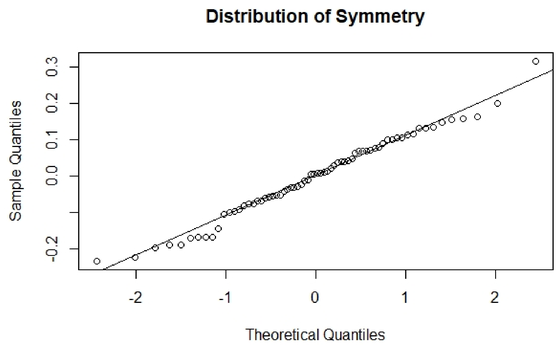

Figure 2: QQ plot of Brain Symmetry

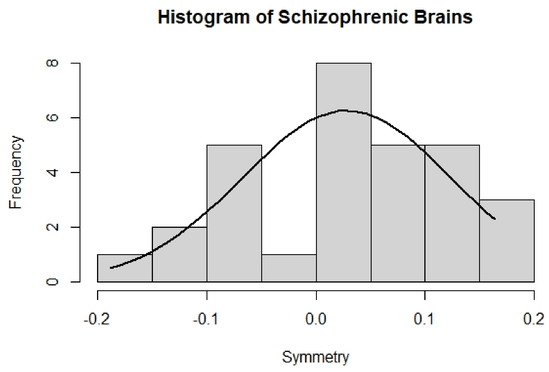

Figure 4: Histogram of Schizophrenic Brains

Conclusion

Even though the equation including sex as a factor does not allow for a zero coefficient on Group, once we break the data down by sex and remove it from the equation, again, we find possibility of a weight of 0 on the group in terms of brain schizophrenia. Of course, further testing into the importance of weight upon sex and whether or not it plays a significant role on brain symmetry could help alleviate some remaining questions. It is also worth noting that the sample of women is especially low in this dataset - 14.

References

[1] Edward W. Frees. *Regression Modeling with Actuarial and Financial Applications. International Series on Actuarial Science.* Cambridge University Press, 2010.

Future Research

Next semester, I will be studying Statistical Inference, Introduction to Statistical Learning, and Time Series Application. In the summer, I will be learning Experimental Design. In the fall, I will complete my Statistical Capstone.

Contact Information

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