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Relationship Between Handwriting Slant and Demographic Features

Research Question

- Is there a relationship between handedness and slant?
- Is there a relationship between gender and slant?

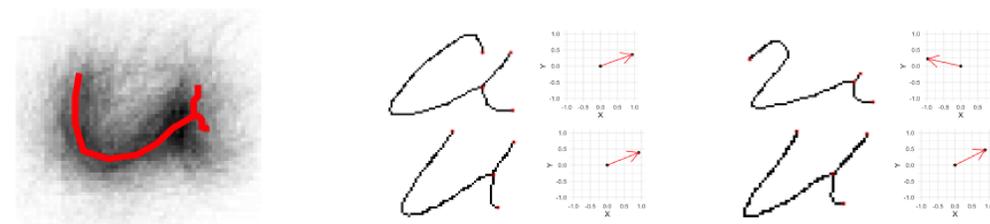
Abstract

While studies have been conducted on whether there are relationships between handwriting and demographic features, this study aims to provide statistical support for the relationships to handwriting slant specifically. Handwriting samples were collected from 90 adults. These handwritten images were then broken into smaller segments of writing that we call “glyphs” by the handwriter R package. For each glyph, a quantitative measure of slant called the rotation angle is computed. We then fit a regression with the demographic information as explanatory variables and the rotation angles as the response. As rotation angles live on a circle, the regression model is based on a probability model appropriate for this type of data - a circular regression. It is hypothesized that females will have more of a slant in handwriting than males and left-handed writers more of a slant than right-handed writers.

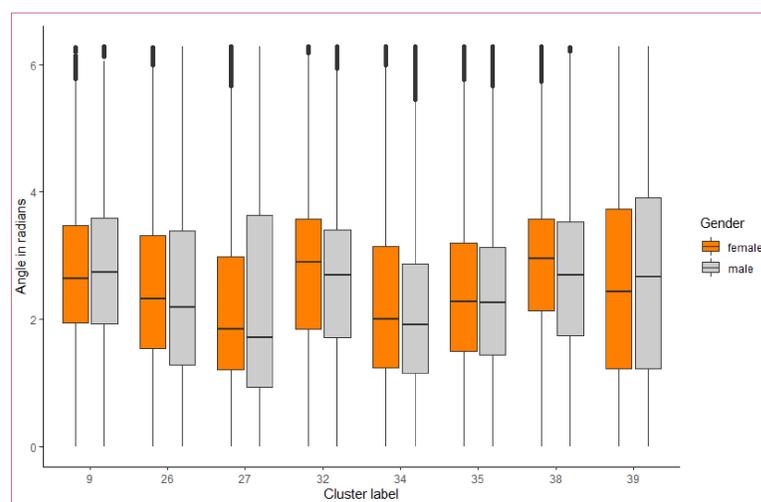
Methods

The Center of Statistics and Applications in Forensic Evidence already conducted a study to collect handwriting data. Handwriting samples were collected from 90 adults for the purpose of developing statistical approaches to the evaluation of handwriting as forensic evidence. Each participant completed three data collection sessions, each at least three weeks apart. At each session, a survey was completed, and three writing prompts were each transcribed three times. The data presented in this study were collected by me and other researchers at the Center for Statistics and Applications in Forensic Evidence (CSAFE) at Iowa State University.

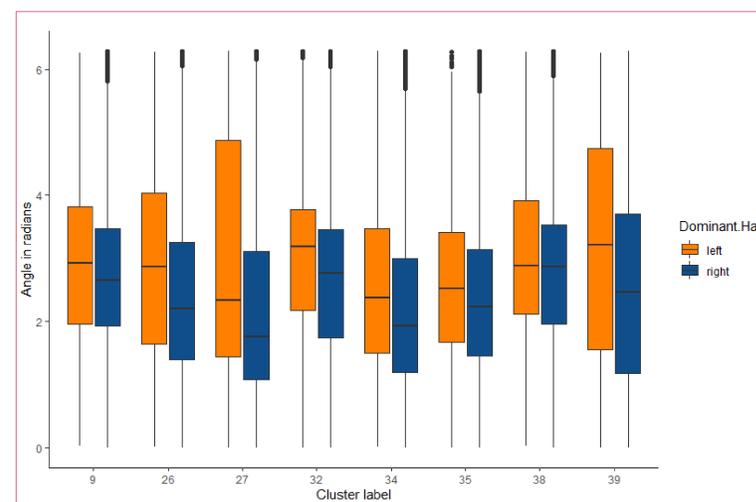
Survey data include information about the participant's handedness, age group, gender, and location of third-grade education. These handwritten images are then broken into smaller segments of writing that we call “glyphs” or “glyphs” by the handwriter R package. These glyphs are then grouped according to their basic shape into 40 different clusters. For each glyph in a cluster, a quantitative measure of slant is computed. The slant of a writer is determined by calculating the direction of greatest variability in a glyph using principal component decomposition and the angle of rotation corresponding to that direction. An example image is shown below of a cluster and possible rotations angles. We then fit multiple models using the circular and bpnreg packages in R. We fit multiple ANOVAs, a Bayesian Projected Normal Regression model, and a Bayesian Projected Normal Regression Mixed Effect model.



Results:



Gender:
Coefficients: Estimate Std. Error t value Pr(>|t|)
[1,] 2.1718 0.1282 16.94 <2e-16



Handedness:
Coefficients: Estimate Std. Error t value Pr(>|t|)
[1,] 1.00000 0.06467 15.46 <2e-16

Conclusion/Next Steps

- Is there a relationship between handedness and slant? ✓
- Is there a relationship between gender and slant? ✓

Next, we will be averaging the rotation angles per cluster per person to reduce variability, interpreting results from the Bayesian models, as well as attempting to fit more models with different variables to see if other demographic features influence the slant of a writer.