

Classification of Skulls Using Craniometrics

By Shannon McChesney

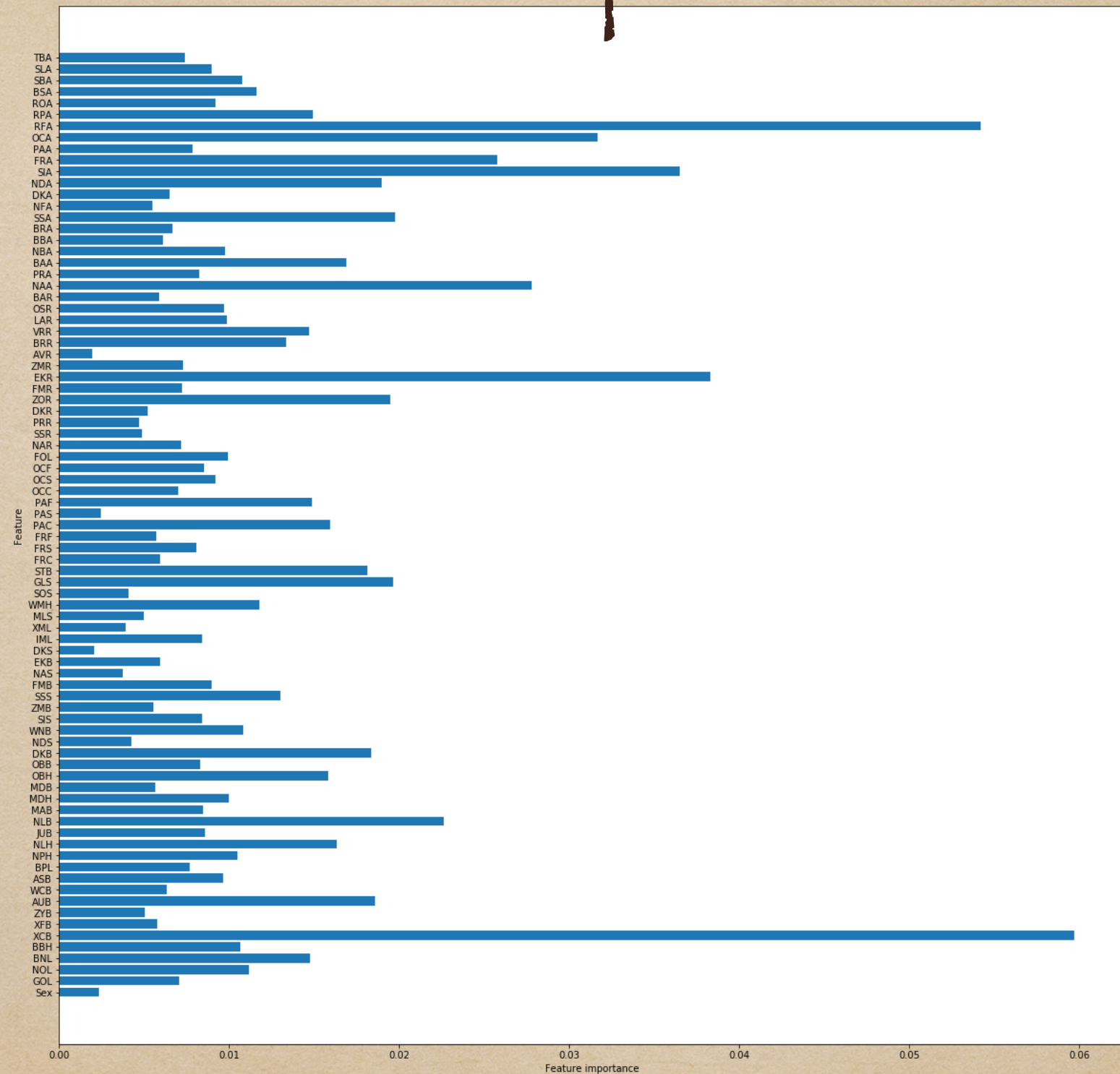
About the Research Samples



An artist's interpretation of Caesarea Maritima's harbor and lighthouse. Painting source: National Geographic

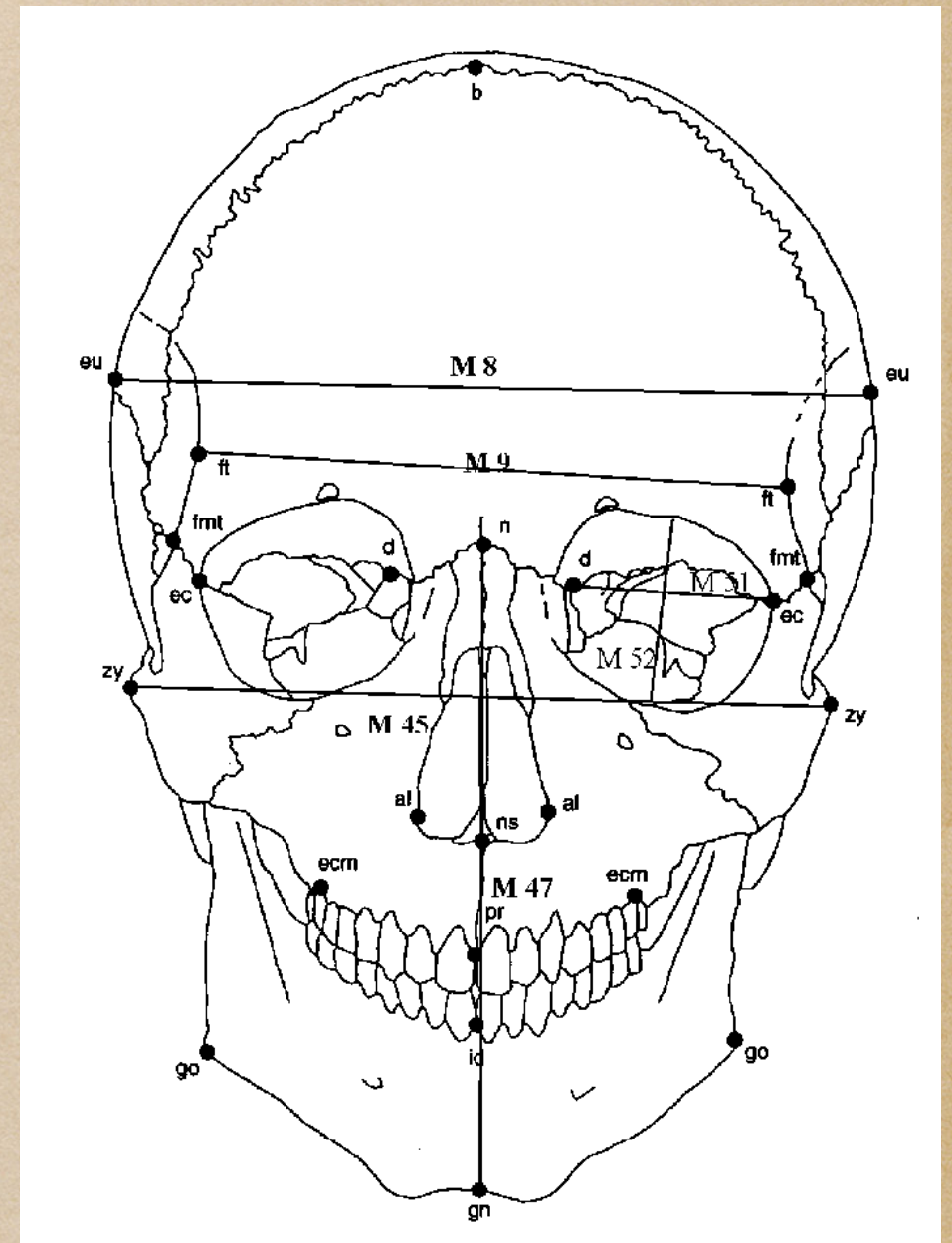
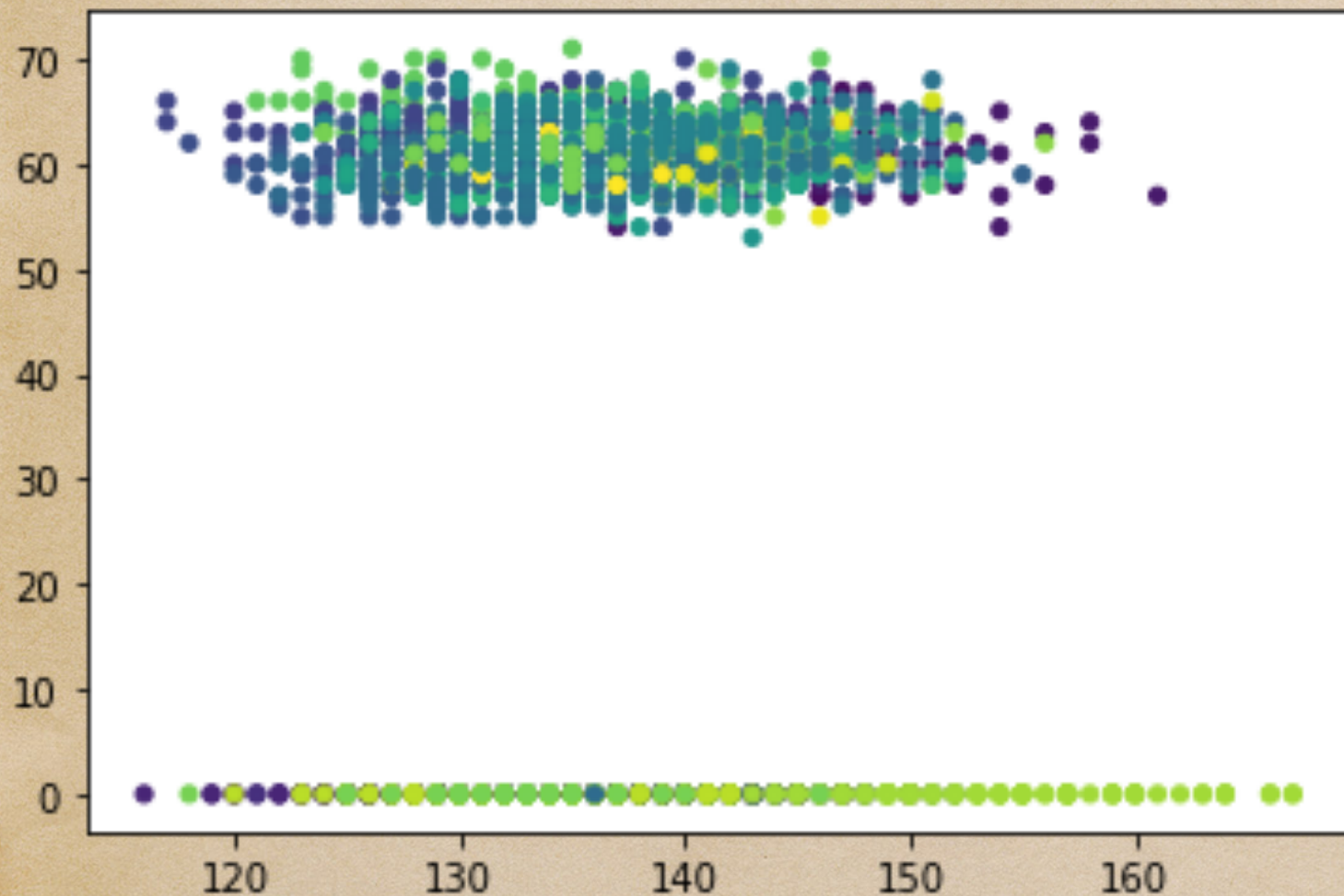
- The skulls that I will attempt to classify using machine learning programming are from the archaeological site of Caesarea Maritima, situated approximately halfway between Tel Aviv and Haifa.
- According to the field reports from the excavations, the skulls are from the Second Crusade.

Feature Importance



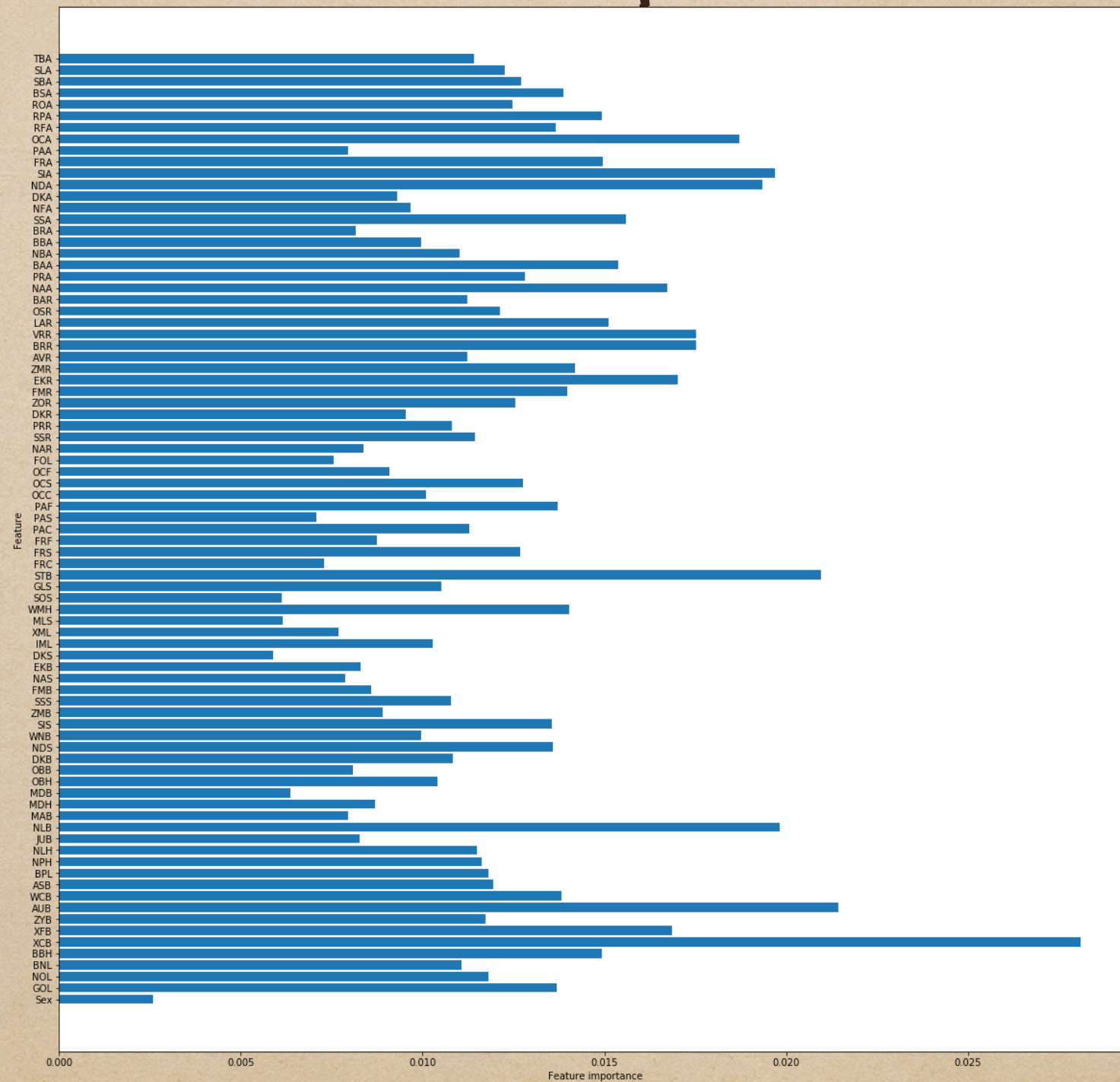
Howells Dataset // Decision Tree Classifier

Scatter Plot of Two Most Important Features



$x = \text{XCB}$ [maximum cranial breadth (M8 in the above right image)] /
 $y = \text{RFA}$ [radio-frontal angle (n to b on the above right figure)]

Feature Importance



Howells Dataset // Random Forest

Scatter Plot of Two Most Important Features

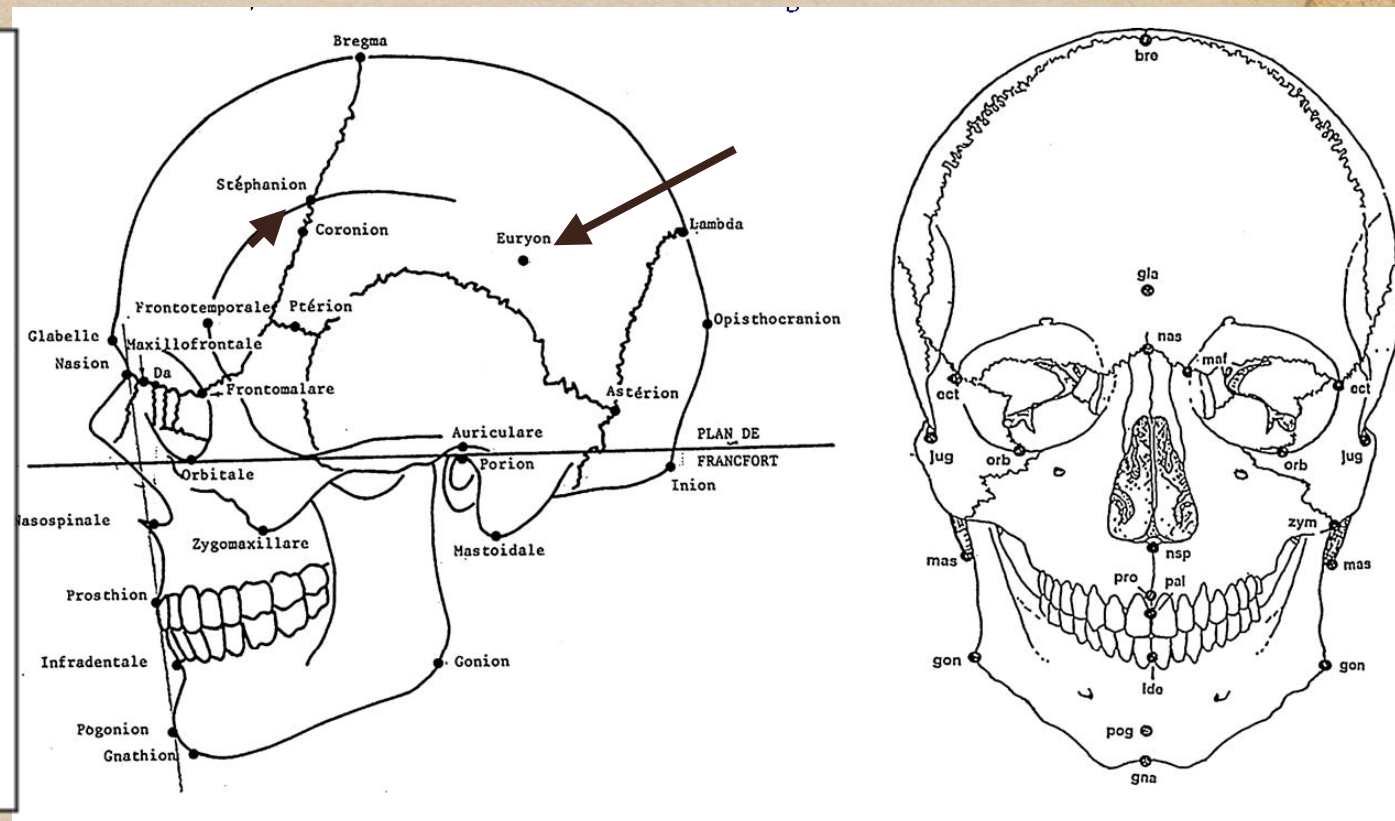
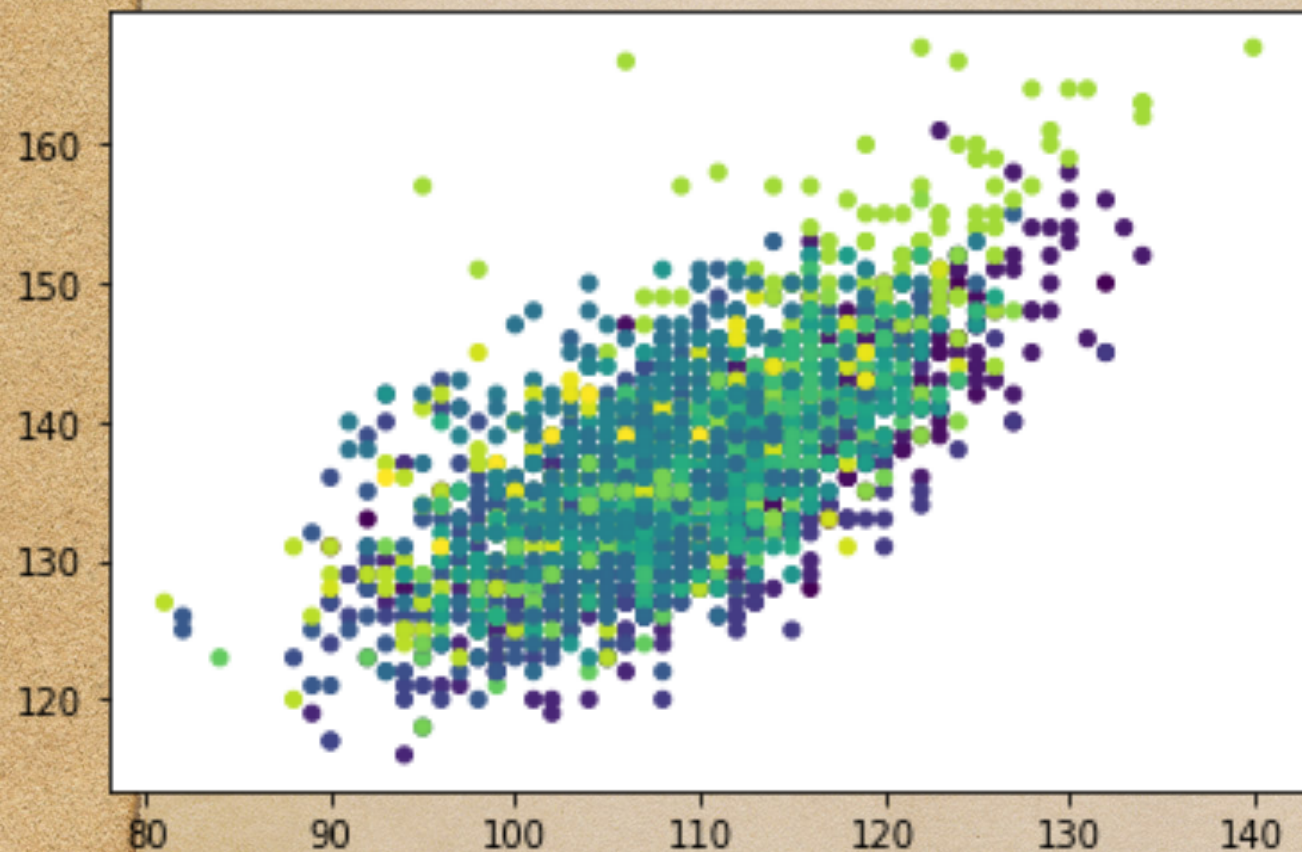
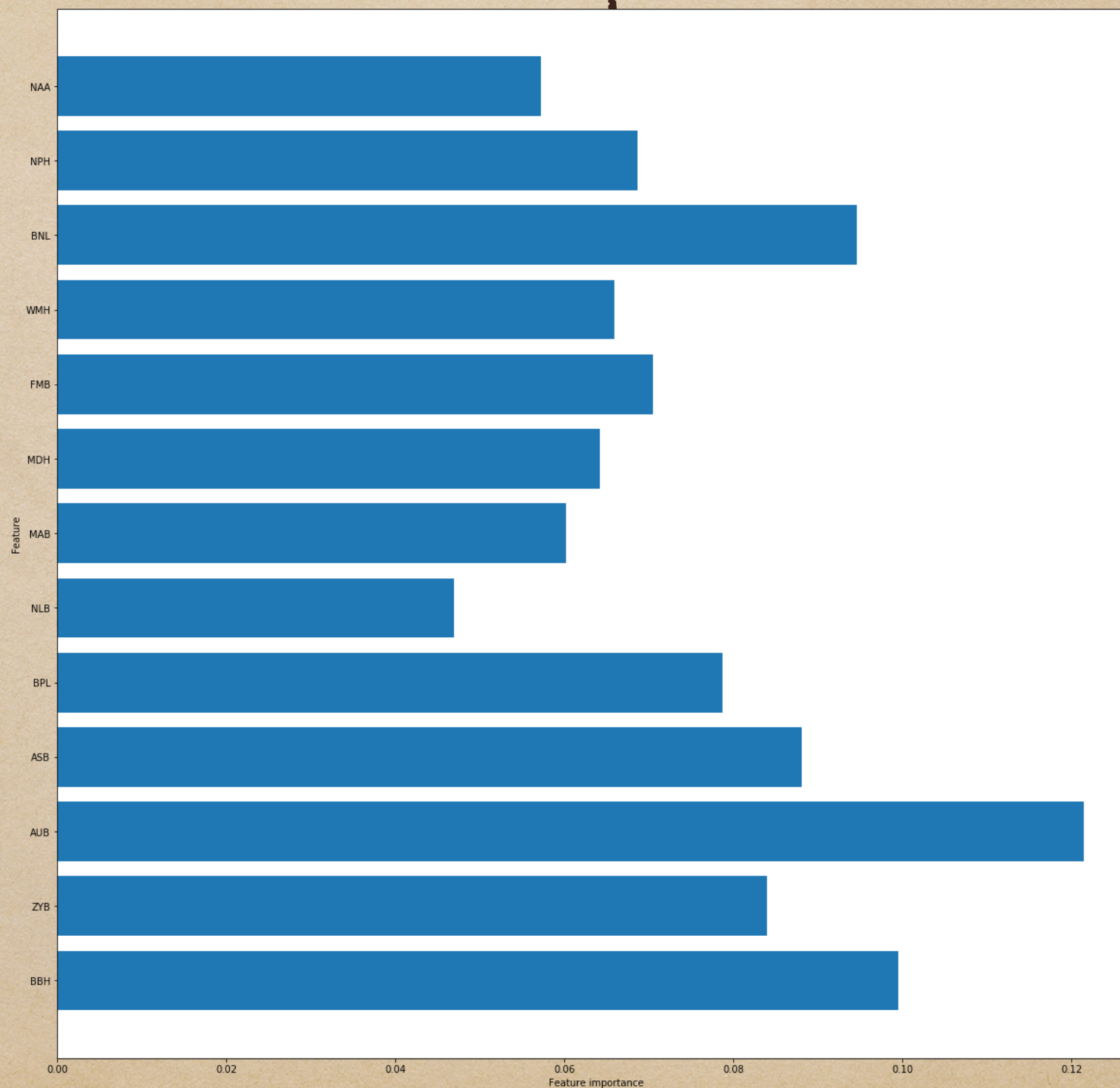


Fig. 1. Skull anatomical landmarks

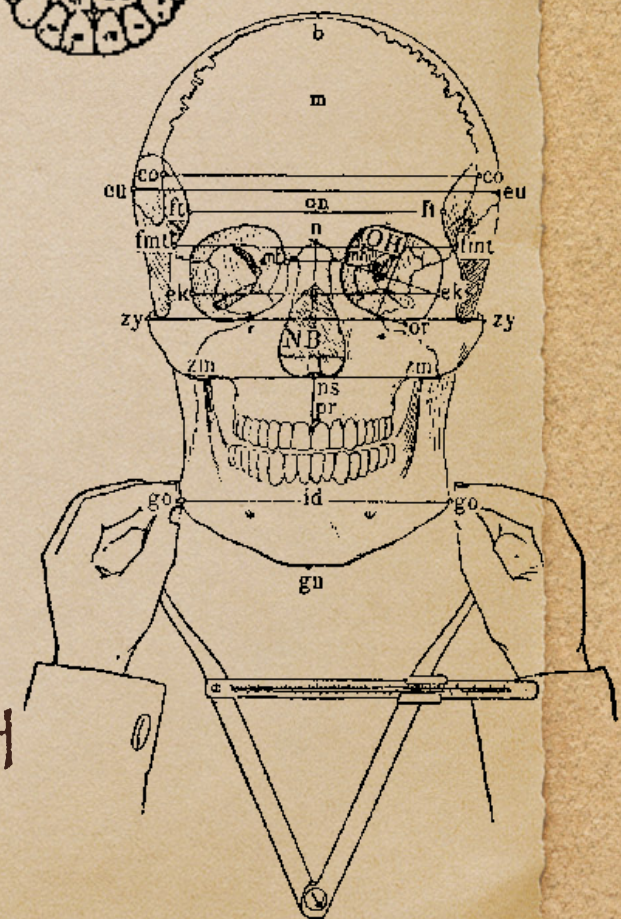
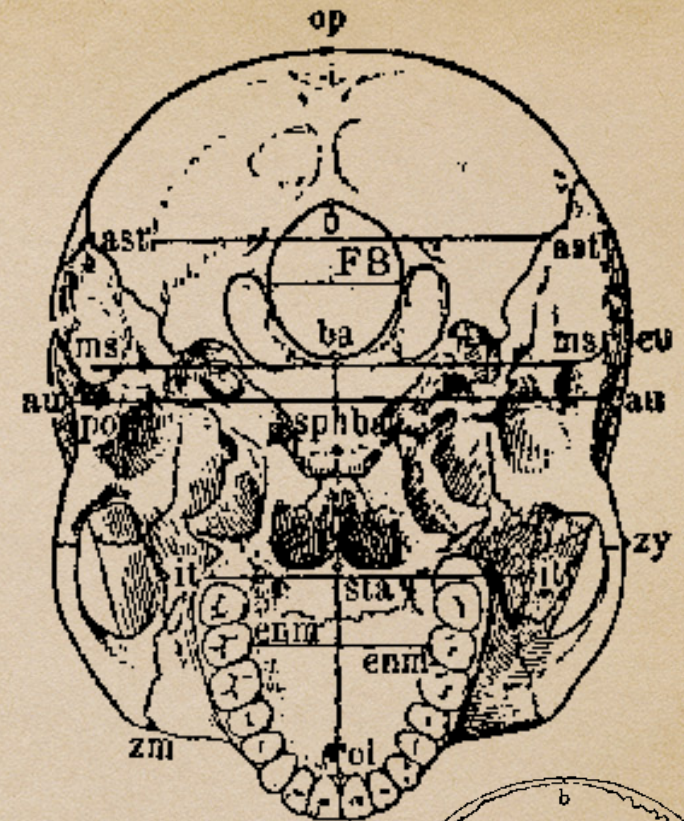
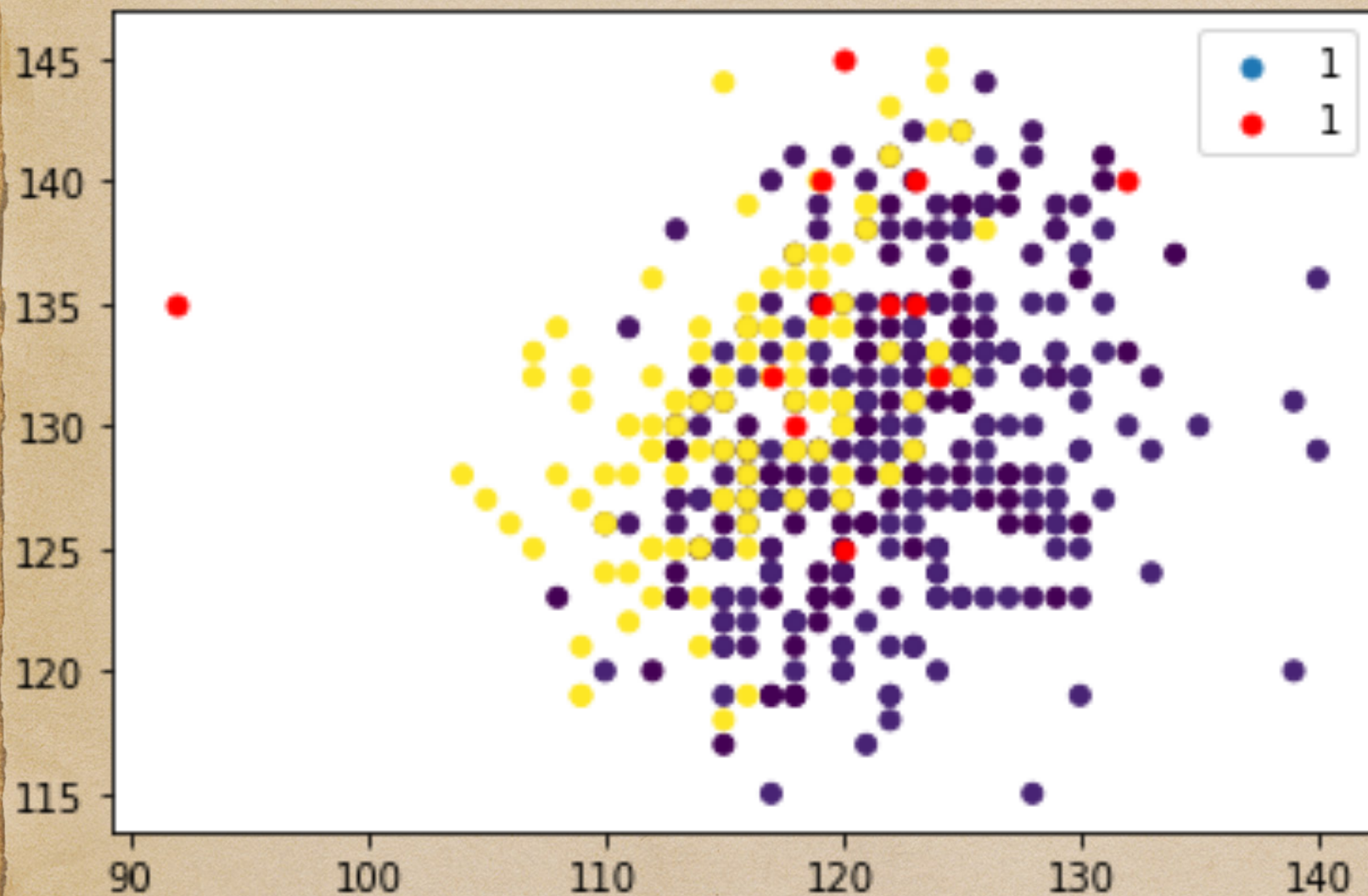
$x = \text{STB (Bistephanal Breadth)} / y = \text{XCB (Maximal Frontal Breadth)}$

Feature Importance



Relevant Groups // Random Forest

Scatter Plot of Relevant Skull Groups and Test Skulls



$x = \text{AUB (Biauricular Breadth)} / y = \text{BBH}$
(Basion-Bregma Height)

Conclusions

- ◆ Limited sample size and lack of data for the most important features in the present samples hinder the accuracy of classification
- ◆ Skulls remain unclassified

Further Research

- Comparison against known Frankish and Abbuyid skulls
- Addition of larger samples of each of the known groups to fine-tune training data
- Further measurements taken (where possible) on test data
- Combine craniometric data with genomic data to refine statistics

Sources

Howells Dataset¶

- Howells Database Website (Dr. Auerbach at UT-Knoxville): <https://web.utk.edu/~auerbach/HOWL.htm>
- Howells WW. 1973. Cranial Variation in Man. A Study by Multivariate Analysis of Patterns of Differences Among Recent Human Populations. Papers of the Peabody Museum of Archeology and Ethnology, vol. 67, pp. 259. Cambridge, Mass.: Peabody Museum.
- Howells WW. 1989. Skull Shapes and the Map. Craniometric Analyses in the Dispersion of Modern Homo. Papers of the Peabody Museum of Archaeology and Ethnology, vol. 79, pp. 189. Cambridge, Mass.: Peabody Museum.
- Howells WW. 1995. Who's Who in Skulls. Ethnic Identification of Crania from Measurements. Papers of the Peabody Museum of Archaeology and Ethnology, vol. 82, pp. 108. Cambridge, Mass.: Peabody Museum.

Caesarea Maritima Craniometric Dataset¶

- McChesney S. 2012. Undergraduate Senior Research Project. Unpublished.