Proposal Biol 607 – fall 2023

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Body mass is one of the significative variables in the biology of an organism. Body mass (BM) could tell us about their physiology, ecology, or behavior. Indeed, BM could be a driver in the speciation and extinction rates in particular groups. However, although it is easy to get BM from extant species, it is an issue when we want to get this variable for extinct organisms. There are many ways to reconstruct body size, shape, and weight from the preserved skeletal dimensions. Two of the most popular are volumetric density (VD) and extant scaling (ES). Especially, ES in quadrupeds uses femur and humerus circumference as predictors, supporting the idea that the animal weight would be distributed on both bones, becoming a good predictor of BM. However, in bipeds, all its weight is kept by the forelimbs. In this case, researchers have omitted humerus measures and have used only femur circumference as a predictor. The problem is that only one covariant in the model could overestimate the predictions. Given that, I would like to explore femur length as a potential predictor of body mass in bipeds. Thus, my question is: Could I improve the BM estimation, including femur length as a predictor?

2. A general framework for the data that you will be using to answer these questions.

To answer my question I will gather data from four different papers[1,2,3,4]. These researches give me information about body size in current bipeds (Birds and humans), femur length, and femur circumference. Additionally, information about sex is measured in some fossils.

3. Preliminary thoughts on the types of analyses you might use to approach the data. These do not have the be excessively detailed, as you still have many tools and techniques to learn!

First of all, I would like to explore normality for body mass, femur circumference (FC), and femur length (FL), and see the collinearity between FC and FL. Estimate the correlation between BM FL and FC independently, and then together. Also, I would like to integrate FC and FL as index variables, calculating area and volume (considering the femur as a cylinder). Then, fit a linear model and compare each other. I will evaluate the error of the prediction and use k-fold cross-validation, AIC, and Malloc techniques to determine the best model.

1 Campione, N. E., & Evans, D. C. (2020). The accuracy and precision of body mass estimation in non-avian dinosaurs. Biological Reviews, 95(6), 1759-1797.

2 Chan, N. R. (2017). Phylogenetic variation in hind-limb bone scaling of flightless theropods. Paleobiology, 3 43(1), 129-143.

3 Campione, N. E., Evans, D. C., Brown, C. M., & Carrano, M. T. (2014). Body mass estimation in non-avian bipeds using a theoretical conversion to quadruped stylopodial proportions. Methods in Ecology and Evolution, 5(9), 913-923.

4 Field, D. J., Lynner, C., Brown, C., & Darroch, S. A. (2013). Skeletal correlates for body mass estimation in modern and fossil flying birds. PLOS one, 8(11), e82000.