H60   What's in a Number: Statistical Paradigm Shifts in Forensic Anthropology

Natalie R. Shirley, PhD, Alicja K. Kutyla, MS, and Richard Jantz, PhD, University of Tennessee, Department of Anthropology, 250 South Stadium Hall, Knoxville, TN 37996*

After attending this presentation, attendees will become familiar with statistical paradigm shifts in forensic anthropology and understand how these shifts relate to greater philosophical trends prevalent during the major historical periods of the discipline. Additionally, attendees will learn about limitations of various statistical methodologies and current statistical requisites in forensic anthropology will be discussed.

This presentation will impact the forensic science community by establishing a coherent statistical history of forensic anthropology and by offering suggestions at a time when the profession is working to recommend appropriate standards and best practices for age, sex, ancestry, and stature estimation.

The history of forensic anthropology (FA) is divided into three periods based on the degree to which the field was organized as a professional discipline (i.e.; Formative, Consolidation, and Modern Periods). Notable statistical trends run throughout FA, and these trends follow a similar progression. The role of statistics in FA has elevated from insignificant (no pun intended) to prime player. This escalating emphasis on statistical rigor in FA is linked to intellectual, technological, and political stimuli.

During the Formative Period, FA was primarily a descriptive discipline within osteology, wherein three of the four primary components of the biological profile (age, sex, and ancestry) were determined on the basis of descriptive parameters. Early descriptive methods of estimating age, sex, stature, and race are described by Thomas Dwight in 1878 (*The Identification of the Human Skeleton: A Medicolegal Study)* and in a series of papers from 1881-1905. H.H. Wilder and Bert Wentworth reiterate Dwight's descriptions in *Personal Identification* (1918) and add criteria for sex estimation from the pelvis and skull. Shortly thereafter, Todd (1920) published his descriptive aging criteria on the pubic symphysis. Early methods of ancestry estimation focused on metric and non-metric traits. Although most of these methods were not developed for forensic utility (i.e., Hooton's Peabody forms, Hrdlička's *Anthropometry*, and Pearson's *Coefficient of Racial Likeness*), they played a major role in later developments. Likewise, correlation coefficients and regression formulae for stature estimation were available as early as the late 1800s; these were not developed for forensic use, but influenced later developments in stature estimation.

The Consolidation Period marked a turning point in FA history primarily due to the publication of Krogman's *Guide to the Identification of Human Skeletal Material* in 1939. During this period, an increasing number of physical anthropologists became interested in its forensic application and began researching modern skeletal variation, especially during WWII. The influx of research literature provided the intellectual impetus for developing more accurate and objective methods. Trotter and Gleser (1952, 1958) developed regression equations for stature estimation using a young, modern sample. Giles and Elliot (1962, 1963) broke statistical ground in sex and ancestry estimation with their pioneering use of discriminant functions, thereby paving the way for decades of discriminant analyses on all imaginable bone measurements. Descriptive techniques gradually gave way to statistical methods, with the use of multivariate statistics advancing primarily due to readily available computing packages. Nonetheless, age estimation resisted the statistical pull, with seriation and accompanying sample descriptive statistics remaining an industry standard.

The Modern Period began when the Physical Anthropology section of the AAFS was formed in 1972. By this time, modern computing power was opening up new statistical possibilities, and the growing understanding of the intricacies of modern skeletal variation explicated a need for quantification. Discriminant functions continued to be popular in sex and ancestry estimation and software development began in the 1980s using Giles and Elliot's functions. The 1993 release of FORDISC 1.0 radically changed sex and ancestry estimation for forensic anthropologists and made easy computation available to anyone with a set of calipers and an osteometric board. However, greater statistical awareness also fostered an understanding of the limitations of some of these methods, and researchers sought alternatives to compensate for these weaknesses. Further stimulus was provided by the 1993 *Daubert* decision. The millennium marked a statistical turning point, and geometric morphometrics, maximum likelihood and Bayesian approaches began receiving considerable attention in the forensic anthropology literature. In addition, established error rates became a necessary focus in the field, along with developing objective and repeatable standards.

For 2010, the Scientific Working Group for Forensic Anthropology is actively establishing "best practice" within the discipline. Consequently, it is imperative that forensic anthropologists are conscious of the statistical background in the field and are aware of current statistical trends as appropriate standards are recommended for age, sex, ancestry, and stature estimation. This presentation aims to acquaint attendees with statistical foundations in FA and to offer suggestions for future direction.

Forensic Anthropology, Statistical Methods, Daubert Standards