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Quantifying Archaeology

If archaeologists do anything, it is count. We count stones, bones, potsherds, seeds, buildings, settlements, and even particles of earth – virtually everything that constitutes the archaeological record. We also measure essentially everything that we touch. Length, weight, thickness, depth, volume, area, color, and height are only some of the simplest measurements taken. We are exaggerating only slightly when we state that our predilection for counting and measuring ensures fame (if not fortune) to anyone who brings to our attention some forgotten or never known aspect of the archaeological record that archaeologists should be counting and/or measuring.

Most archaeologists are in the counting and measuring business not for its own sake, but to help us fashion a meaningful perspective on the past. Quantification isn't required to back up every proposition that is made about the archaeological record, but for some propositions it is absolutely essential. For example, suppose we proposed an idea about differences in Hallstatt assemblages in Central Europe that could be evaluated by examining ceramic variation. Having observed hundreds of the pots, we could merely assert what we felt the major differences and similarities to be, and draw our conclusions about the validity of our original idea based upon our simple observations. We might be correct, but no one would take our conclusions seriously unless we actually took the relevant measurements and demonstrated that the differences and/or similarities were meaningful in a way that everyone agreed upon and understood. Quantification and statistics serve this end, providing us with a common language and set of instructions about how to make meaningful observations of the world, how to reduce our infinite database to an accurate and understandable set of characterizations, and how to evaluate differences and similarities. Importantly, statistics do this by using a framework that

allows us to specify the ways in which we can be wrong, and the likelihood that we are mistaken. Statistics consequently provide archaeologists with a means to make arguments about cause that will ultimately help us construct explanations.

Statistical thinking plays an important role in archaeological analysis because archaeologists rely so heavily on samples. The archaeological record contains only the material remains of human activity that time and the vagaries of the environment (including human activity) have allowed to be preserved. The artifacts, features, and other material manifestations of human behavior that enter the archaeological record are only a small subset of those originally produced. Funding constraints, time limits, and our emphasis on conserving the archaeological record further dictate that archaeologists generally recover only a small subset of those materials that have been preserved. Thus, we have a sample of the material remains that have been preserved, which is only a sample of all of the materials that entered the archaeological record, which is only a sample of all of the materials that humans have produced.

Archaeologists are consequently forced to understand and explain the past using imperfect and limited data. Connecting our sample to a meaningful understanding of the past necessitates the application of a statistical framework, even when quantitative methods are avoided as part of a purportedly humanistic approach. It is only through statistical reasoning, no matter how implicit, that any form of general conclusion can be formed from the specifics of the archaeological record. Regardless of whether an archaeologist studies the social differentiation of Cahokia's residents, subsistence shifts during the Mexican colonial occupation of New Mexico, or the religious systems of Upper Paleolithic cave dwellers, they are going to employ a statistical approach, even if they don't acknowledge it. Quantitative methods allow us to make this approach explicit and make our arguments logically coherent and thereby facilitate their evaluation. Even the most ardent humanist should appreciate this.

As important as statistics are, we must remember that they are only tools, and subservient to theory. Our theoretical perspectives tell us which observations are important to make and how explanations are constructed. Statistics are useful only within this larger context, and it is important to remember their appropriate role. It is also important to recognize that the use of statistics does not equal science. The historical confluence of events that brought statistics, computers, the hypothetico-deductive method, and the theoretical advances of the New Archaeology to our discipline in a relatively brief span of time in the 1960s make it appear that they are inseparable. Nothing could be farther from the truth. While this might seem self-evident, at least one quite popular introductory archaeology textbook overstates the relationship, as a discussion of the role of science in archaeology begins with a brief discussion of statistics. Not the role of theory, not the scientific method, but statistics! Statistics do not a science make, and statistical analyses conducted in the absence of theory are merely vacuous description.

This book approaches quantification and statistics from the perspective that they are a simple set of tools that all competent archaeologists must know. Most readers

will use statistics innumerable times throughout their career. Others may never calculate a mean or standard deviation willingly, but at least they will know the basics of the statistical tool kit. Choosing not to use a tool is fine. Remaining ignorant is unfortunate and unnecessary. At the very least, knowledge of statistics is needed to evaluate the work of others who do use them.

So, why should two archaeologists write a book about statistics when there are thousands of excellent statistics books in existence? Here are our reasons in no particular order. First, few of us entered archaeology because we wanted to be mathematicians. In fact, many archaeologists became interested in archaeology for very humanistic (or even romantic) reasons, and many avoided math in school like the plague. There definitely needs to be a book that is sympathetic to those coming from a non-quantitative background. We seek to achieve this goal by presenting the clearest description of techniques possible, with math no more complicated than simple algebra, but with enough detail that the reader will be able to actually understand how each technique operates.

Second, most statistics textbooks use examples that are not anthropological, and are very hard to relate to the archaeological record. While knowledge of dice examples is useful when playing craps in Las Vegas, the implications of these examples for archaeological studies are often difficult to decipher. Our examples are almost exclusively archaeological, and we hope that they provide good illustrations of how you might approach various archaeological data sets from a statistical perspective.

Third, archaeologists do not always need the standard set of statistics that are presented in popular textbooks. Some techniques of limited importance to archaeology are overemphasized in these texts, while other extremely important statistical methods are underemphasized or do not appear at all.

Fourth, it is our observation that many degree-granting programs in archaeology focus solely on computer instruction in quantitative methods rather than on the tried and true pencil and paper method. We have nothing against the use of computers and statistical software, as long as it is done by people who first learn statistical techniques by putting pencil to paper. However, our experience has shown us that when all training is focused on using a statistical package instead of learning a statistical method, the computer becomes a magic black box that produces "results" that students who don't know what actually happened inside the box are (hopefully) trained to interpret. This lack of understanding causes confusion and, more importantly, embarrassment when insupportable or erroneous conclusions are drawn. These students need a friendly text to which they can refer to help clarify how the quantitative methods work and how their results should be understood.

Finally, many disciplines use samples, but few are as wholly reliant on them as is archaeology. This in turn means that the application of quantitative reasoning has special significance in archaeological research that needs to be explored if we are to produce the best archaeological analyses we can. This consideration is absent from statistical texts written for general audiences, but should be central to those specifically for archaeologists. It certainly will be central to the discussions that follow this chapter.

Ultimately, our goal is to illustrate the utility and structure of a quantitative framework to the reader (i.e., you), and to provide a full understanding of each statistical method so that you will understand how to calculate a statistical measure, why you would want to do so, and how the statistical method works mathematically. If you understand these issues, you will find each method to be intuitively meaningful and will appreciate the significance of its assumptions, limitations, and strengths. If you don't understand these factors, your applications will be prone to error and misinterpretations, and, as a result, archaeology as a discipline will suffer. Hopefully, this text will serve to aid you, gentle reader, as we all work to accomplish our collective goals as a discipline.

Practice Exercises

1   Identify five attributes of artifacts or features that archaeologists routinely measure. Why do archaeologists find these attributes important? What information do they hope to gain from them?

2   Identify an archaeological problem that might interest you. What attributes of archaeological materials might be useful for your research problem? Why would you select these attributes as opposed to any others that might be possible?