Quantitative Methods in Archaeology Using R

Quantitative Methods in Archaeology Using R is the first hands-on guide to using the R Statistical Computing System written specifically for archaeologists. It shows how to use the system to analyze many types of archaeological data.

Part I includes tutorials on R with applications to real archaeological data showing how to compute descriptive statistics, create tables, and produce a wide variety of charts and graphs. Data transformation and missing values are also covered. A chapter on confidence intervals and hypothesis testing introduces these statistical concepts and provides examples of several approaches including bootstrapping. Associations between variables including Chi-square tests, and simple linear regression completes the section on basic statistics. Part II addresses the major multivariate approaches used by archaeologists including multiple regression (and the generalized linear model); multiple analysis of variance and discriminant analysis; principal components analysis; correspondence analysis; distances and scaling; and cluster analysis. Part III covers specialized topics in archaeology including intra-site spatial analysis, seriation, and assemblage diversity.

David L. Carlson is a Professor of Anthropology at Texas A&M University where he has been teaching quantitative methods and the R statistical system to anthropology graduate students for eight years. His research focuses on the application of quantitative methods to discover and understand patterning in the distribution of artifacts on archaeological sites. He is a co-author of *Clovis Lithic Technology* (2011).

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CONTENTS

FIGURES

TABLES

BOXES

ACKNOWLEDGMENTS

I first began teaching anthropology students how to use the R statistical computing system in my graduate quantitative methods class in 2008, having used SAS, SPSS, and various other programs before. As open source and freely available worldwide for Windows, MacOS, and Linux, R was an obvious alternative. It is also the only software that readily accomplishes all of the quantitative analyses that archaeologists routinely employ. Anything that is not included in the base R system is covered in one of several thousand packages.

My interest in quantitative methods spans several decades beginning in a seminar taught by J. Ned Woodall at Wake Forest University. We were required to read a minimum number of articles or book chapters each week and I ran across a large book in the library that I thought would keep me occupied for several weeks. *Analytical Archaeology* by David L. Clarke did exactly that and illustrated many ways that quantitative approaches could facilitate the analysis of archaeological data. Later at Northwestern University, I studied with Bob Vierra, James A. Brown, and Stuart Struever and began applying quantitative methods to the Koster site for my dissertation research along with fellow students including John Hewitt, Sarah Neusius, and Mike Wiant.

At Illinois State University, I worked with Ed Jelks and Fred Lange learning to apply quantitative approaches to historic and prehistoric sites investigated during cultural resources investigations. That research continued at Texas A&M with Harry Shafer, Vaughn Bryant, Jr., and D. Bruce Dickson. It also involved a wide range of projects ranging from reservoir surveys and excavations in Texas (in collaboration with Kate Mueller Wille, Joe Saunders, and Alston Thoms) to a nineteenth-century sugar plantation in Mexico (with students Alan Meyers and Sam Sweitz). With Ron Bishop, W. Dennis James, M James Blackman, and Shawn Carlson, I was able to learn more about the analysis of ceramic compositions.

More recently, I collaborated with Michael Waters and Charlotte Pevny in analyzing the Clovis component in an excavation at the Gault Site in *Clovis Lithic Technology*. I am currently working with Michael Alvard on Domenican fishing activities using R to identify different fishing techniques from global positioning system (GPS) locational data.

While applying R to archaeological problems in my research, I also began to develop teaching materials for other archaeologists in the form of companion guides for introductory statistics texts for archaeologists, including Stephen Shennan's *Quantifying Archaeology* and Robert Drennan's *Statistics for Archaeologists*. I also began pulling data sets included in Michael Baxter's *Exploratory Multivariate Analysis in Archaeology* and *Statistics in Archaeology* to make them more easily available to my students. Those data sets and others are incorporated into the R package, `archdata`, that is used throughout the book. I have also benefited by participating in the r-help mailing list where an amazing range of people ask and answer questions about how to use R in their research.

I am indebted to all of these people for stimulating my interest in quantitative methods and suggesting interesting ways to apply them to archaeological data. I also appreciate the patience of my wife, Shawn, over the last several years that this book has been in development and my repeated promises that it was "almost" done.

The anonymous reviewers of the original manuscript lead to substantial improvements in the final product and the staff at Cambridge University Press, including Beatrice Rehl, Asya Graf, and Edgar Mendez, have been patient and supportive during the process.

My thanks also to Marion Coe who created Figures 5, 6, 9, and 41.