How Can Bayesian Smoothing and Correspondence Analysis Help Decipher the Occupational Histories of Late-eighteenth Century Slave Quarters at Monticello?

Frazier Neiman and Karen Smith—Monticello Department of Archaeology

Introduction

Two problems hinder effective intensive spatial analysis:

1. Small samples from individual quadrats with uncertain or variable type frequencies in their associated error variances.
2. The meaning of quadrat groups—created by clustering quadrats on the basis of similarity in type frequencies—often unclear.

In this paper, we build on earlier work (Robertson 1999; Neiman et al. 2000) to explore two promising solutions: Bayesian smoothing and correspondence analysis (CA).

Boyes in Space

Bayes’s theorem offers an elegant means to address the sample-size problem. Bayes’s theorem allows one to combine prior information about type frequencies likely to occur in a given quadrat, characterized by “prior” probability distributions, with type frequencies actually found therein to produce smoothed estimates that have lower sampling error than the raw ones.

Correspondence Analysis (CA)

Qualitative data such as ceramic type frequencies have been examined by both temporal and spatial variation. Correspondence analysis (CA), a dimension reduction technique, when combined with Bayesian smoothing, can be used to examine simultaneous variation in several groups of data. CA, based on cluster analysis, confounds these patterns of variation. CA offers a means to deconfound them.

CA and Frequency Seriation

The frequency seriation model stipulates that type frequencies change smoothly through time. Bayesian smoothing in conjunction with CA may help discern patterns in artifact-type frequencies in each 5-foot quadrat using neighborhoods with 40-foot radius. The meaning of quadrat groups—groups of quadrats that fall within the same local area, from the same cultural tradition, or from the same local area and with high artifact densities or features. For more see our current guess is that an assemblage group represents a seriation model’s assemblage group.

Site Background

Our case study examines two adjacent sites on Monticello Mountain, occupied by slaves and an overseer during the second half of the 18th century. We used the phenomenon of a mixed-method sample of 45-foot quadrats, followed by more intensive pilot analyses sampling adjacent quadrats with high artifact densities. This means we can more accurately assess variations among the assemblage groups, especially among Site 8.

Synthesis

How do the assemblage groups relate to one another in time and spatially? Temporal relationships among them are summarized and compared using three methods: Frequencies, BLUES MDS, and Site 7 Analysis

Site 7 Analysis

We compared the raw estimates of type frequencies in each 5-foot quadrat using neighborhoods with 40-foot radius. CA suggests the two groups of assemblages (7-1, 7-2), the second of which is further divided into three subgroups (7-2a, 7-2b, 7-2c). The type scores indicate that Assemblage 7-1 has maximum-likelihood estimates of their temporal assemblages on the first CA axis approximate uniformly distributed in time, the scores of assemblages on the first CA axis approximate maximum-likelihood estimates of their temporal variation among the types associated with Axis 2. However, here there are unlikely to be cost differences among the types associated with Axis 2.

CA Axis 2

The frequency seriation model stipulates that type frequencies change smoothly through time. Bayesian smoothing in conjunction with CA may help discern patterns in artifact-type frequencies. CA can be used to deconfound them.

Site 7 Analysis

We compared the raw estimates of type frequencies in each 5-foot quadrat using neighborhoods with 40-foot radius. CA suggests the two groups of assemblages (7-1, 7-2), the second of which is further divided into three subgroups (7-2a, 7-2b, 7-2c). The type scores indicate that Assemblage 7-1 has maximum-likelihood estimates of their temporal assemblages on the first CA axis approximate uniformly distributed in time, the scores of assemblages on the first CA axis approximate maximum-likelihood estimates of their temporal variation among the types associated with Axis 2. However, here there are unlikely to be cost differences among the types associated with Axis 2.

CA Axis 2

The frequency seriation model stipulates that type frequencies change smoothly through time. Bayesian smoothing in conjunction with CA may help discern patterns in artifact-type frequencies. CA can be used to deconfound them.

Discussion

If the groupings are noted on their Site 8 axes, the type scores roughly approximate the major groups of assemblages. Site 7 analysis produces two major groups of assemblages. Site 8 analysis produces two major groups of assemblages.

Acknowledgements

We thank Sara Bon-Harper and Derek Wheeler for collaboration in this research, Leah Stearns for her graphical wizardry (and patience), and the prior research of many whose work contributed to this project. We express our gratitude to Robert注销 the previous note that Monticello is a site in Virginia, specifically the site where Thomas Jefferson’s Monticello is located.

The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeological data, as summarized in tables and figures, are available from the authors. The raw archaeolog...