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

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Introduction

Bayes in Space

- Bayes’ theorem offers elegant means to address the sample-size problem. Bayes’ theorem shows how one can combine information about type frequencies within a given quadrat, characterized by a “prior” probability distribution, with type frequencies actually found to produce smoothed estimates that have lower sampling error than the raw counts.

- The Bayesian estimates honor, in a statistically defensible fashion, 1) sample size in a given quadrat, 2) mean similarity of a quadrat’s type frequencies to the average value for the neighborhood, and 3) mean uncertainty about type frequencies within quadrats in a neighborhood. Bayesian estimates are, therefore, superior to common methods that rely on simple weighted moving averages (e.g., Neiman 1998; Whallon 1984).

Correspondence Analysis (CA) and Frequency Seriation

Spatial variation in artifact type frequencies often is studied by both temporal and social variation. Common practices in archiological spatial analysis, based on cluster analysis, confound these dimensions of variation. CA offers a means to disentangle them.

CA and Frequency Seriation

The frequency seriation model stipulates that artifact type frequencies vary in time-display heliopolis-shaped, or logistic, response curves, providing the requirements of the variation model are met.

In plotting the physical locations of assemblage groups, we see that Site 8 corresponds with a rock chimney base of the south of the overseer. The affinities between Site 8 and 8-2b and 8-3b suggest that the latter captures time.

The CA of Site 8 assemblages produced a point scatter in the shape of a sideways battleship-shaped, or Gaussian, response curves, which we reexpress as and a vector of means, .

Site 7 Analysis

We compared historical remains of type frequencies in each 5-foot quadrat using neighborhoods with a 40-foot radius. CA suggests there are two major groups of assemblages (+1, -1, 0), the second of which is further divided into three subgroups (+1, 0, -1).

In this poster, we build on earlier work (Robertson 1999, Neiman et al. 2008) to explore two promising relations: Bayesian smoothing and correspondence analysis (CA).

The site of Monticello is a sea of sampling variation. Consider the quadrats that fall within the boundaries of a 40-foot radius. CA suggests there are two major groups of assemblages (+1, -1, 0), the second of which is further divided into three subgroups (+1, 0, -1).

Each artifact type, or artifact group, was considered as a separate variable. The variable scores were based on 5 x 5-foot quadrats in which all artifact types were recorded.

The CA of Site 7 assemblages produced a point scatter in the shape of a sideways battleship-shaped, or Gaussian, response curves, which we reexpress as and a vector of means, .

The type scores indicate that Site 7 ca. 1815, with early types on the right and late types on the left. Site 2 may represent synchronous variability as cost, with cheaper ware types at the top and more expensive ones at the bottom.

Discussion

We evaluated the hypothesis that Site 7 captures time by comparing BLUE mean density scores (MDSs) for each assemblage. The correlation with Axis 1 scores is strong.

We tested the plowzone using a stratified-random sample of 5-foot quadrats, followed by more refined stratified samples as necessary. We tested the plowzone using a stratified-random sample of 5-foot quadrats, followed by more refined stratified samples as necessary.

Site 8 Analysis

The CA of Site 8 assemblages produced a point scatter in the shape of a sideways battleship-shaped, or Gaussian, response curves, which we reexpress as and a vector of means, .

The type scores again indicate that Site 8 ca. 1815, with early types on the right and late types on the left. Site 2 may represent synchronous variability as cost, with cheaper ware types at the top and more expensive ones at the bottom.

As at Site 7, the correlation between the BLUE-MDSs and Axis 1 scores confirms that the latter captures time.

Synthesis

- How do the assemblage groups relate to one another in time and social space? Temporal relationships among them are summarized (AND) by plotting Site 7 Group 2 against BLUE-MDSs.

- Site 7 Group 2 is much earlier than the others. It represents the mid-18th century occupation by slaves belonging to Peter Jefferson. The remaining groups date ca. 1775-1800 and belong to Thomas Jefferson’s Monticello Plantations.

- There are two additional significant dimensions of variation among the assemblage groups, captured by Site 2 and Axis 1 scores. With the exception of Site 7, the subgroups display historical continuity within major groups. Why is Site 7 so much like Site 8 and Site 8b?