

## 21 Estimating Site Occupation Spans from Dated Artifact Types: Some New Approaches

Vincas P. Steponaitis  
University of North Carolina  
Chapel Hill, North Carolina

Keith W. Kintigh  
Arizona State University  
Tempe, Arizona

Over the years, archaeologists have developed many quantitative methods for dating proveniences based on artifact types. Most such methods involve some form of seriation, which is based on a model that treats individual proveniences as points to be placed in sequence along a temporal scale. Because of this underlying model, seriation methods can be productively applied only to proveniences that represent relatively brief intervals (i.e., points) in time, such as gravelots, pits, and short-term midden deposits. Complete site assemblages or surface collections, on the other hand, are often unsuitable for seriation because there is no guarantee that such collections represent short, much less equivalent, spans of time. Quite the contrary, sites, even if found within the same region, can have greatly differing spans of occupation, which may overlap to varying degrees. If one attempts to seriate such sites, the solution will be at worst meaningless, and at best a distortion of the true chronological relationships, since seriation methods are inherently incapable of recognizing different spans of occupation or expressing the different degrees of temporal overlap that may exist (Rouse 1967; Dunnell 1970; Cowgill 1972; Marquardt 1978).

Among those most actively concerned with this problem have been historical archaeologists, who, over the past 20 years, have proposed a number of

quantitative algorithms for estimating the temporal span during which a site was occupied, given an assemblage of artifact types whose periods of manufacture (or use) are known (South 1972, 1977; Salwen and Bridges 1977; Bartovics 1980, 1981; Carlson 1983). What these algorithms seek has been termed *arrangement* (Schiffer 1975), as distinct from *seriation*, for the result is not simply a relative ordering, but rather an estimate of the actual beginning and ending dates of each site's occupation.

By far the best known of these arrangement algorithms is South's (1972, 1977) "visual bracketing method." This method begins with a "ceramic bar graph" like Figure 21.1, in which the horizontal axis represents time and the span of each ceramic type is depicted as a bar parallel to this axis. South described the essentials of his procedure as follows:

a method I have used for a number of years involves placing a vertical bracket to the left and right on the ceramic bar graph, with the resulting time span between being the *interpreted* period, inside of which the occupation of the site took place. The placing of the left [starting] bracket is determined by choosing the point at which at least half of the ceramic type bars are touching or intersecting the bracket. The right [ending]

bracket is placed generally using the same rule; however, it must be placed far enough to the right to at least touch the beginning of the latest type present. An exception to this is surface collections from sites revealing multiple occupation periods as revealed in a gap or discontinuity between the ceramic bars of the first occupation period and those of the later period. In such cases brackets for both occupations must be placed . . . [South 1977:214].

South demonstrated the effectiveness of this pioneering method by applying it to a series of historic sites with known dates (1977:214-230). Yet despite its heuristic value, the method does have certain practical and theoretical limitations. One minor problem stems from an ambiguity in the rule for estimating dates: in practice, there is often more than a single point at which a bracket may touch or intersect half the bars. Thus, different researchers employing South's algorithm might well arrive at different estimates of a site's occupation span (Jelks 1972:177-178). Another, more worrisome problem

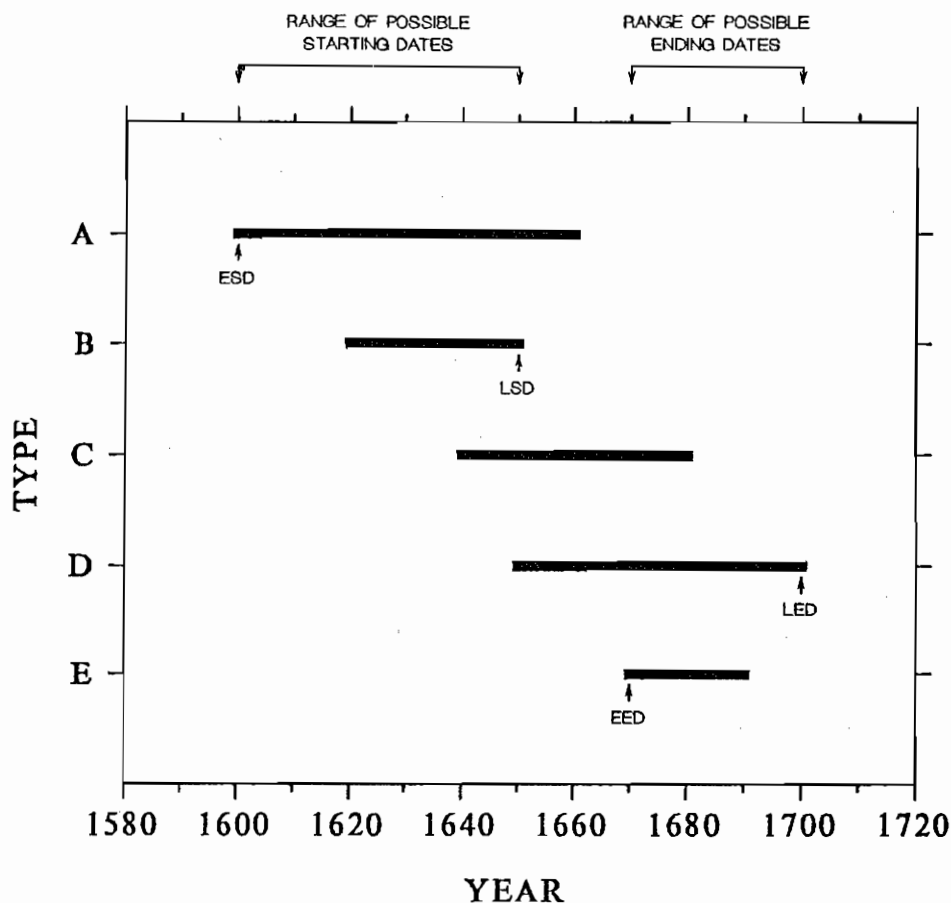


Figure 21.1. Ceramic bar graph for a hypothetical assemblage of five types. Logically, the boundaries of the site's occupation span may be defined by four key dates: the earliest starting date (ESD), the latest starting date (LSD), the earliest ending date (EED), and the latest ending date (LED). See text for further explanation.

is the lack of a theoretical justification for placing the brackets where he does. While the method seems to work, it is not at all clear *why* it should work. Other things being equal, it is usually better to use methods whose underlying logic is more explicit, so their theoretical and practical limitations can be better understood.

Salwen and Bridges's (1977) method uses a modified version of South's ceramic bar chart, in which the height of each bar is varied in proportion to the type's abundance. Abundant types can thus be given greater weight than rare ones in interpreting the graph qualitatively. They further suggest that a site's occupation span can be estimated quantitatively by calculating weighted means of the initial and final manufacturing dates, respectively, of the types comprising the assemblage. These means, they say, "should represent the most probable initial and final dates of occupation of the sites or features from which the collections were obtained, just as the mean ceramic date should mark the central tendency" (1977:167-169). Although this quantitative procedure is unambiguous, it too suffers from a lack of theoretical justification in that Salwen and Bridges fail to offer any mathematical or logical argument in support of the assertion just quoted.

Bartovics (1980, 1981) and Carlson (1983) take a different approach to estimating occupation spans. Their methods, although independently invented, are essentially the same: both rely on a graph of what Carlson calls a "composite ceramic distribution." For each type, the number of sherds in the assemblage is mathematically distributed over the known range of that type's manufacture or use. The distribution can be assumed to be uniform, Gaussian (i.e., "normal"), or of any other shape. The distributions of the individual types are then added together to produce the composite distribution for a given assemblage. This curve is analogous to a probability distribution, with the area under the curve suggesting the likelihood that the site was occupied over any given interval of time. Beginning and ending dates are then estimated by visual inspection; the site's

span of occupation is assumed to correspond to the "fattest" part of the curve. This approach has the advantage of being based on an explicit mathematical model, but, in the absence of any rules for bracketing occupation spans, it shares the drawback of South's technique of being highly subjective in its application.

Building on these previous attempts, our goal here is to present some additional methods that entail both an explicit theoretical framework *and* explicit rules for estimation. We begin by presenting a simple mathematical model that shows how site occupation spans are logically related to the known use-dates of the artifact types that are found in the archaeological record. This model is then used as a basis for constructing two algorithms—one using type *presence*, the other using type *frequencies*—for estimating the actual span of occupation. The utility of these algorithms is examined by applying them to data from historic sites in the southeastern United States.

## THE MODEL

Let us begin by considering an ideal archaeological site for which the following conditions hold: (1) artifacts are deposited at the site continuously throughout its occupation and (2) the artifacts deposited at any point in time are a representative sample of those generally in use. Let us further assume that the overall period of each artifact type's use is known. For any type (*i*), this period of use can be bracketed in terms of two dates: the initial date ( $a_i$ ) when the type begins to be used, and the terminal date ( $z_i$ ) when the type disappears.

Given these conditions, one can easily deduce the range of dates within which the occupation and abandonment of the site must have occurred. A site's occupation could not have started any earlier than the initial production date of the earliest type at the site; otherwise an earlier type should be present. Thus, the earliest possible date the occupation could have begun (henceforth referred to as the earliest

starting date, or ESD) is the earliest initial date of any artifact type present, or

$$\text{ESD} = \min(a_i).$$

Similarly, the latest possible starting date (LSD) of the site's occupation is the earliest terminal date of any artifact type present, or

$$\text{LSD} = \min(z_i).$$

If the site had started any later, the type with the earliest termination date would not occur. Exactly the same logic can be used to find the range of possible ending dates for the site's occupation. The earliest ending date (EED) is equal to the latest initial date of any type present, whereas the latest ending date (LED) is the latest terminal date of the types present. These relationships can be rewritten as follows:

$$\text{EED} = \max(a_i),$$

$$\text{LED} = \max(z_i).$$

To the extent that the assumptions of the model hold true, the site's occupation must have begun during the interval between the ESD and the LSD and must have ended during the interval between the EED and LED. No other interpretation is logically valid.

These concepts are simply illustrated in Figure 21.1, where types A through E are shown as being present at the site in question. The earliest starting date is 1600, the initial date of type A. The latest starting date is 1650, the terminal date of type C. Similarly, the earliest ending date is 1670, marked by the introduction of type D, and the latest ending date is 1700, marked by the termination of type B. Hence, the site was first occupied between 1600 and 1650, and abandoned between 1670 and 1700.

The model just presented does nothing more than specify the range of possible starting and ending dates for a site's occupation. Such a result is useful, so far as it goes, but in many situations a more

precise estimate of the occupation span may be required. For this reason we have developed two algorithms for deriving unique, "best" estimates of the starting and ending dates, estimates that are constrained to fall within the theoretically plausible ranges.

### MIDPOINT METHOD

The first method simply takes the midpoint of the plausible range to be the best estimate of the date in question. In other words, the estimated starting date (EstSD) can be computed as

$$\text{EstSD} = (\text{ESD} + \text{LSD})/2,$$

and the estimated ending date (EstED) can be expressed as

$$\text{EstED} = (\text{EED} + \text{LED})/2.$$

These estimates are not only simple to calculate, but also have the statistical advantage of minimizing the largest error that could conceivably occur. That is, the error ( $e$ ) in the length of the estimated occupation span can never exceed half the sum of the starting and ending ranges, or

$$e_{\max} = [(\text{LSD} - \text{ESD}) + (\text{LED} - \text{EED})]/2.$$

Where the maximum error is small relative to the estimated span of occupation, this method is virtually guaranteed to produce a satisfactory result.

The effectiveness of this algorithm can be illustrated by applying it to ceramic assemblages from two sets of historic sites in the southeastern U.S.

The first set consists of 12 eighteenth-century sites from the Carolinas with documented dates of occupation—the same sites against which South originally tested his visual bracketing method (South 1977:214-230). The necessary ceramic data were supplied by South (1977:254-259, Table 31). Following South's suggestion, types with date ran-

ges greater than 140 years were excluded from the analysis because such types are of little help in constructing fine chronologies and tend to inflate artificially the range of possible starting and ending dates. South himself dealt with this problem by excluding types 26, 39, and 65 entirely and by subdividing the span of type 49 into two segments—one used for sites that are “obviously” of the seventeenth century and the other used for sites believed to be of the eighteenth century (South 1977:213). This way of handling type 49 seems problematic for several reasons, not the least of which are (1) the inconsistency with the handling of other long-last-

ing types, (2) the circularity inherent in using different spans for the same type based on preconceptions about the site’s date, and (3) the fact that the subdivisions are purely arbitrary, and that changing their boundaries could affect the outcome of the analysis. For present purposes, we simply eliminated type 49 from all our calculations, thereby treating it just like the other types with overly long spans.

Table 21.1 summarizes for each site the historical dates, the estimated spans based on South’s method, and the estimated span based on our midpoint method. The average error of the estimated

Table 21.1. Historical and estimated dates for eighteenth-century sites.

Site Name	Estimated Dates <sup>b</sup>				
	Historical Dates <sup>a</sup>	Bracketing Method <sup>c</sup>	Midpoint Method <sup>d</sup>	Percentile Method (12.5–87.5) <sup>e</sup>	Percentile Method (35–90) <sup>f</sup>
First Fort Moore	1716–1747	1690–1775	1660–1791	1645–1762	1680–1762
Fort Moore	1716–1766	1690–1775	1722–1767	1710–1760	1720–1760
Brunswick Ruin S7	1734–1776	1740–1775	1720–1791	1710–1785	1745–1790
Brunswick Ruin S15	1726–1776	1740–1795	1722–1817	1705–1795	1740–1795
Brunswick Ruin N1	1731–1776	1720–1775	1722–1777	1725–1765	1745–1765
Brunswick Ruin S2	1731–1776	1740–1795	1720–1817	1710–1795	1735–1795
Brunswick Ruin S18	1763–1776	1720–1795	1720–1817	1755–1795	1775–1800
Fort Prince George	1753–1768	1740–1780	1720–1797	1735–1790	1755–1790
Brunswick Dump S10	1776–1830	1760–1820	1722–1830	1750–1830	1800–1835
Goudy’s Post Plow Zone	1751–?	1740–1800	1737–1787	1750–1795	1770–1795
Goudy’s Post Cellar	1751–1760	1740–1775	1737–1760	1735–1765	1750–1765
Paca House	1763–?	1740–1780	1730–1800	1735–1790	1750–1795

<sup>a</sup> After South (1977: Table 33).

<sup>b</sup> All estimates are based on the ceramic type dates given by South (1977: Table 31). The sherd counts for each site are also taken from South (1977: 253–260). All ceramic types with spans of 140 years or greater were excluded from the analysis (i.e., types 26, 39, and 49).

<sup>c</sup> As described by South (1977: 214–216). All the dates herein were derived by applying the method consistently as follows: the brackets were moved inward toward the mean ceramic date until each bracket just intersected the spans of at least half the types present in the sample. The right bracket, however, was never moved to the left of the latest beginning date of the types in the assemblage. It should be noted that the estimates so derived do not always match the estimates published by South (1977: Figure 33, Table 33). The source of these discrepancies is not entirely clear.

<sup>d</sup> The proportional maximum error—i.e., the maximum possible error ( $e_{max}$ ) divided by the estimated span of occupation—is calculated for each site as follows: First Ft. Moore, .53; Ft. Moore, 1.78; Brunswick S7, 1.11; Brunswick S15, .79; Brunswick N1, 1.28; Brunswick S2, .75; Brunswick S18, .75; Ft. Prince George, .94; Brunswick S10, .55; Goudy’s Post Plow Zone, 1.20; Goudy’s Post Cellar, 2.50; Paca House, .86. Values of this index less than one indicate that the greatest possible error is smaller than the estimated span of occupation; the lower the value, the less serious the potential for error.

<sup>e</sup> The beginning date is estimated from the 12.5th percentile; the ending date is estimated from the 87.5th percentile.

<sup>f</sup> The beginning date is estimated from the 35th percentile; the ending date is estimated from the 90th percentile.

Table 21.2. Average error of estimated dates.<sup>a</sup>

Estimation method	Average error relative to all historical dates (years)	Average error relative to plausible historical dates (years)
South's bracketing method	15.5	13.7
Midpoint method	22.9	15.8
Percentile method (12.5-87.5)	16.9	12.9
Percentile method (35-90)	13.4	9.9

<sup>a</sup> The average error is the arithmetic mean of the absolute value of the difference between the estimated starting or ending date and the corresponding historical date.

starting and ending dates for each site, when compared to the historical dates, is 22.9 years for our method and 15.5 years for South's (Table 21.2).

At first glance it seems that our method has a somewhat greater tendency to overestimate a site's actual occupation span than does South's method. Yet when we examine the data more closely, it becomes apparent that the problem may stem not so much from the estimating procedures, but from the historical dates to which the estimates are being compared. Note that for five of the 12 sites, the alleged historical dates fall *outside* the range of plausible dates as determined by our theoretical model (Table 21.3). In each of these cases, the historical ending date is substantially earlier than the earliest possible ending date derived from the ceramics in the deposit. This can only mean two things: either the historical dates are wrong, or the archaeological deposits are contaminated with later

Table 21.3. South's historical dates compared with theoretically possible dates.

Site Name	Range of Possible Starting Dates <sup>a</sup>	Historical Starting Date <sup>b</sup>	Range of Possible Ending Dates <sup>a</sup>	Historical Ending Date <sup>b</sup>
First Fort Moore	1650-1700	(1716) <sup>c</sup>	1762-1820	(1747)
Fort Moore	1660-1775	1716	1740-1802	1766
Brunswick S7	1670-1770	1734	1762-1820	1776
Brunswick S15	1660-1775	1726	1795-1840	(1776)
Brunswick N1	1660-1775	1731	1759-1802	1776
Brunswick S2	1660-1770	1731	1795-1840	(1776)
Brunswick S18	1660-1770	1763	1795-1840	(1776)
Fort Prince George	1660-1770	1753	1775-1820	(1768) <sup>d</sup>
Brunswick Dump S10	1660-1775	1776	1820-1840	1830
Goudy's Post Plow Zone	1700-1775	1751	1775-1820	?
Goudy's Post Cellar	1700-1775	1751	1740-1780	1760
Paca House	1690-1770	1763	1780-1820	?

<sup>a</sup> Based on the model described herein.

<sup>b</sup> Dates that fall substantially outside the theoretically plausible range are given in parentheses.

<sup>c</sup> This historical date is rendered "implausible" by the presence of 39 Bellarmine sherds (type 66), whose period of manufacture is said to have terminated at 1700 (South 1977: Table 31). This discrepancy, however, may well be due to an "heirloom effect," in that the durable Bellarmine bottles could well have remained in use long after they ceased being made. Hence, it is entirely possible that the historical date is correct in this case.

<sup>d</sup> Although South places the beginning of Debased Rouen Faience (type number 21) at 1775 for formula dating purposes, he notes that it may occur as early as 1755 on French sites. If the type's span is pushed back to the latter date, then the earliest ending date (EED) for this assemblage becomes 1760, which then renders the historical ending date plausible.

material (a problem that South himself discusses in the case of First Fort Moore [1977:222]). Whichever explanation is correct, one can say *for certain* that the ceramic assemblages at these five sites could not possibly have been deposited entirely within the historical spans reported. This example clearly demonstrates the advantages of using a dating algorithm that is based on an explicit theoretical model, for it is only when the data were examined in light of this model that the anomalies in the historical record became apparent.

As a further test, we also applied the algorithm to historic sites from the region of Natchez, Mississippi, which was first colonized by Anglo-American settlers in the late eighteenth century. Surveys of this region carried out by the Lower Mississippi Survey from 1971 to 1973 produced numerous surface collections from sites of this period (Williams 1979; Brain, Brown, and Steponaitis, n.d.); these collections are now housed at the Peabody Museum, Harvard University. Included in the present analysis are

all sites with significant representations of late eighteenth-century English ceramics that were found in the Natchez Bluffs south of Vicksburg and north of the Louisiana state line—the area of the old Natchez District (Swearingen 1934:33).

Relying on the ceramic type dates provided by South (1972, 1977) and Noel Hume (1970), these collections were used to estimate site occupation spans according to the method just described. Unlike the previous case, we lack documentary dates with which to check the estimates for individual sites. However, when the number of sites that date to every tenth year from 1770 to 1800 is plotted (Figure 21.2b), we find a pattern of monotonic increase through time that parallels the trend seen in historic census figures for the same region (Figure 21.2a). Although we would not claim that each site has been dated with perfect accuracy, it does seem that our estimated dates are at least close enough to the true dates to reflect the overall pattern of population growth described in the documentary record.

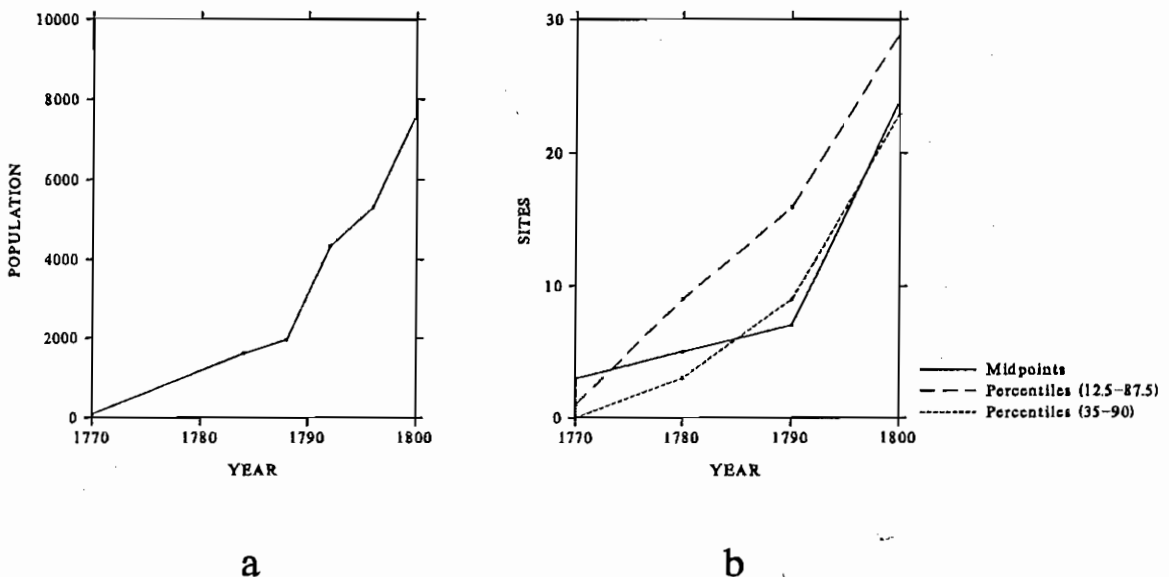


Figure 21.2. A comparison of historical census data and archaeological settlement data from the region of Natchez, Mississippi: (a) historical population trend for the old Natchez District (from Swearingen 1934:34, 36; James 1968:16, 42; Sydnor 1938:17); (b) the number of sites occupied at each decade boundary from 1770 to 1800, estimated using the methods described in this paper.

## PERCENTILE METHOD

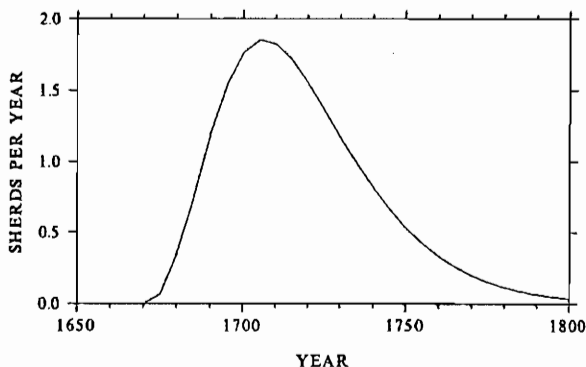
We have also developed a second method that takes into account the relative frequencies of artifact types rather than just their presence. In concept, our method follows the work of Salwen and Bridges (1977) and, more closely, that of Bartovics (1980, 1981) and Carlson (1983). However, unlike the latter two methods, in which the researcher is expected to draw an intuitive conclusion from a graphical presentation, ours provides an explicit algorithm for estimating starting and ending dates within the constraints of the mathematical model outlined earlier.

Generally speaking, the evidentiary value of a type for dating a site's occupation depends on at least two factors: (1) the type's abundance in an assemblage (the more abundant a type, the more important it is for dating a site), and (2) the length of the type's period of use (a type that was distributed for 300 years is generally of less value for questions of dating than one that was produced for only 30 years). These points have been made previously by various authors (e.g., South 1977:213, 217; Jelks 1972:176; Salwen and Bridges 1977).

Since all types are affected by both of these factors, often in opposite directions, we need a way to balance their effects. For example, the importance for dating of an abundant, but long-lived type is increased by its frequency, but decreased because of its long period of manufacture. In addition we need a way to combine the information contributed by several types to derive estimated starting and ending dates for an occupation.

Let us begin by observing that each sherd contributes chronological information of a probabilistic sort. Lacking any better information, the probability that a sherd was deposited in a given year depends on the frequency distribution of its type through time. Prior to the type's starting date, the probability of a sherd being deposited is zero, but during and after the period of manufacture, we assume that the frequency distribution looks like a unimodal "bat-tleship curve." This curve can be assumed to be

either symmetrical (i.e., a gradual increase in popularity followed by an equally gradual decline) or asymmetrical and skewed to the right (i.e., a rapid increase in popularity followed by an extended and more gradual decline). A number of authors have suggested that the latter is a more realistic model for present purposes, and we agree (Walker 1972:130-131; Fitting 1972:161; Cleland 1972:185-186; Liggett 1972:199). If we view this curve as a probability density function, then it will have a total area of 1.0, and by determining the area between any two points on the time axis, we in effect calculate the probability that a given sherd was deposited during the interval defined by those points.



*Figure 21.3. The assumed distribution of a single type through time (lead-glazed slipware, 100 sherds, patterned after a gamma distribution with alpha equal to 3).*

Next, let us transform that curve into one with an area that is equal to the number of sherds of this type at a particular site. Now, the vertical axis represents a deposition rate (sherds per year), and the area between any two points along the horizontal axis is a probabilistic estimate of the number of sherds of this type that were deposited during that time interval (Figure 21.3). If we add together the temporal distributions of all types present at the site, we end up with what Carlson (1983) calls a composite ceramic distribution (Figure 21.4). The area under this curve is simply the total assemblage size,



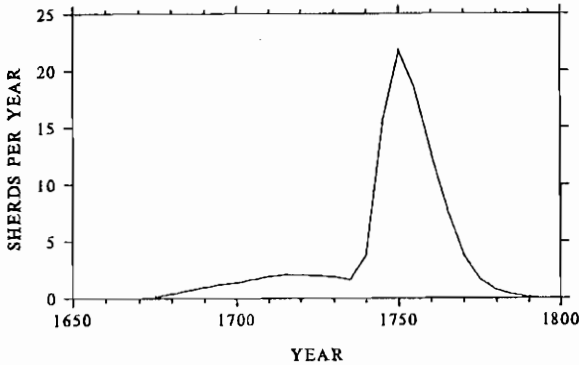


Figure 21.4. The composite ceramic distribution for Brunswick Ruin N1, North Carolina.

and, loosely speaking, the area within any temporal interval estimates the number of sherds that may have been deposited during that period.

Given this model, it seems reasonable to interpret the higher parts of this curve as times of denser occupation. One might, more tentatively, identify the major positive and negative inflection points with the beginning or end of occupation. Note that in spite of certain simplifying (and perhaps even simplistic) assumptions, this procedure has the desired effects. First, types with greater frequencies do have greater influence on the results because they contribute more total area to the composite distribution. Second, the importance of types with long production periods is reduced because their area is spread more widely along the time axis.

While these graphs clearly have interpretive value, we have not yet specified how we might use them to derive estimated starting and ending dates for a site's occupation. In the absence of additional information, we suggest placing the estimated starting date (EstSD) and estimated ending date (EstED) in such a way that 75% of the area of the curve is between these two points, and the remaining area is split equally on the two sides. This procedure is analogous in statistical terms to constructing a 75% confidence interval around the distribution's mean. Thus, the EstSD is placed at the 12.5th percentile,

and the EstED at the 87.5th percentile. Hence, the occupation period of the site is identified with the "deposition" of 75% of the probabilistic sherds (Figure 21.5a). One further qualification is necessary: the EstSD and EstED must fall within the plausible ranges defined by our model. If either of the "boundary percentiles" falls outside of its plausible range, then the estimated starting or ending point becomes the date *within* the plausible range that is closest to the percentile originally chosen.

This algorithm was implemented with a program written in Turbo Pascal on an IBM-compatible microcomputer. The changing popularity of each type was modeled by a gamma distribution—a

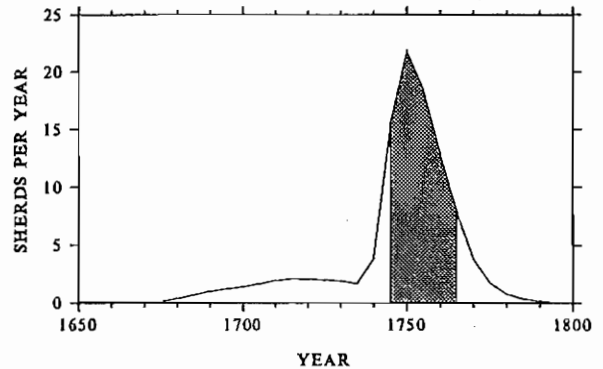
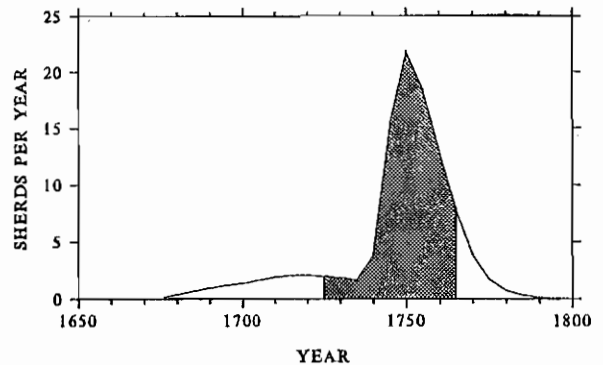


Figure 21.5. The composite ceramic distribution for Brunswick Ruin N1, North Carolina, showing the estimated occupation spans derived using the percentile method. Shaded area represents the portion of the curve defined by (top) the 12.5th and 87.5th percentiles; and (bottom) the 35th and 90th percentiles.

skewed, unimodal curve with a long tail that slopes gradually down to the right (Mood and Graybill 1963:126-129). The shape of this function is governed by a parameter called alpha; the greater the value of alpha, the less skewed the distribution. For present purposes, alpha was set at 3, a value that produced an intuitively pleasing curve in which the popularity of a type rises about twice as fast as it declines (see Figure 21.3). Changing this value to 2 or 4 made little difference in the results, never altering the estimated dates by more than five years. The distribution was scaled to fit each type's history of use: the origin was placed at the starting date, and the tail was placed so that a type produced for  $n$  years had  $1/n$ th the area of the curve (i.e., an average year's production) to the right of the ending date.

When this algorithm was applied to South's data discussed previously (Table 21.1), it produced an average error of 16.9 years with respect to all the historical dates and an average error of 12.9 years with respect to the dates that are plausible in light of our model (Table 21.2). The latter figure is nearly 20% lower than the corresponding error produced by the midpoint method and about 6% lower than

the error produced by South's visual bracketing method. Such minor differences could easily be sample-dependent, and it would be unwise to make too much of them. Nevertheless, the initial results suggest that our percentile method works at least as well as, and perhaps marginally better than, the midpoint and visual bracketing methods.

In fact it may be possible to improve the performance of the percentile method even further. Since the choice of boundary percentiles is arbitrary (in the sense that it is not specified by theory), it makes sense to choose the percentiles that are most likely to produce empirically satisfying results (i.e., percentiles that tend to fall within the plausible date-ranges and to approximate historical dates as closely as possible). While the 12.5-87.5 percentile convention just discussed seems to work reasonably well with the data at hand, it is appropriate to ask whether another set of boundary percentiles might have worked better. One way of addressing this question is to determine where the historical starting and ending dates actually fall within the composite ceramic distribution for each of our sites. As shown in Table 21.4, the plausible historical starting dates

*Table 21.4. The percentiles of historical starting and ending dates in the composite ceramic distribution of each site.*

Site Name	Historical Starting Date <sup>a</sup>	Starting Date Percentile <sup>b</sup>	Historical Ending Date <sup>a</sup>	Ending Date Percentile <sup>c</sup>
First Fort Moore	(1716)	(61.9)	(1747)	(79.5)
Fort Moore	1716	41.2	1766	96.2
Brunswick S7	1734	25.9	1776	75.6
Brunswick S15	1726	40.8	(1776)	(94.8)
Brunswick N1	1731	25.1	1776	98.6
Brunswick S2	1731	41.6	(1776)	(93.5)
Brunswick S18	1763	25.5	(1776)	(48.5)
Fort Prince George	1753	46.7	(1768)	(64.9)
Brunswick Dump S10	1776	28.8	1830	89.7
Goudy's Post Plow Zone	1751	17.5	?	?
Goudy's Post Cellar	1751	54.6	1760	85.9
Paca House	1763	36.8	?	?

<sup>a</sup> Dates that fall substantially outside the theoretically plausible range are given in parentheses (see Table 21.3).

<sup>b</sup> The average percentile of the plausible starting dates (i.e., those not in parentheses) is 35.0.

<sup>c</sup> The average percentile of the plausible ending dates is 89.2.

fall between the 17th and 55th percentiles and have an average very close to the 35th percentile. Similarly, the plausible historical ending dates consistently fall between the 55th and 99th percentiles, with a mean at about the 90th percentile. This suggests that the 35th and 90th percentiles are better estimators of the starting and ending dates, respectively, than the percentiles used in our initial test (Figure 21.5b). A glance at Table 21.2 confirms this suspicion: the average error with respect to the plausible historical dates drops to 9.9 years in comparison to 12.9 years for the other percentile boundaries.

Of course, the latter exercise is not really a test of our method since the procedure used in estimating dates was circular; that is, the estimated dates were based on percentiles that had been calibrated to fit the known historical dates of the very same sites. One can easily imagine other situations, however, in which such calibration procedures could be used without circularity. Say, for example, one is working in a region that contains numerous historical sites, *some* of which have documented historical dates. These known dates could be used to determine the "best-fit" boundary percentiles, which in turn could be applied in estimating the starting and ending dates of the undocumented sites.

With these considerations in mind, the percentile method was also applied to our data from the Natchez region (Figure 21.2b). The 12.5-87.5 percentile boundaries yield the expected pattern of increase in the number of sites through time, albeit with little change in slope after 1790. Interestingly, the 35-90 percentile boundaries produce even better results, duplicating almost exactly the historical pattern of population growth (Figure 21.2a). Indeed, this curve mirrors the historical data even better than the one based on the midpoint method, especially in the interval between 1770 and 1790. While it would be premature to generalize from this single case, our results hint that the 35-90 percentile boundaries may work well in dating eighteenth-century sites throughout the southeastern U.S., not just in the

Carolinas. Clearly, further experimentation is warranted before this matter is resolved.

## CONCLUSION

We have described two methods for estimating the starting and ending dates of a site's occupation based on known temporal spans of the pottery types found in the assemblage. These methods appear to be as good or better predictors than South's visual bracketing method, and have some distinct advantages over his and other methods that have been proposed. Both of our methods are grounded in a theoretical model that specifies the logical limits within which these dates must fall; unlike some previous attempts, both of our methods also entail unambiguous procedures for generating the estimated dates. It now remains for us to consider further some of the limitations and potentials of these techniques as a basis for future application and refinement.

It is important to stress that our methods of estimation depend on a prior knowledge of when ceramic types were *used*. Most published dates on eighteenth-century European pottery, however, are based on documentary evidence of when these types were *made* (e.g., Noel Hume 1974; South 1972, 1977). Needless to say, the two kinds of dates are not always congruent. Although the earliest date of manufacture should provide a reliable *terminus post quem*, most types were probably used for at least some years after manufacturing ceased. Moreover, the vagaries of international commerce sometimes caused interruptions of supply, making certain types unavailable even while they were still being made (Walker 1972:128-130; Jelks 1971:178). Such factors, if ignored, could well cause errors of estimation, but they are not problems inherent in the logic of our methods *per se*. Rather, the problem is an empirical one: if the use-dates of individual types in a particular region are not determined with reasonable accuracy beforehand, any method of es-

timation will fail. For eighteenth-century English pottery in the southeastern U.S., manufacture dates seem to provide a reasonable outline of when types were used, at least as a first approximation (South 1972, 1977). As researchers continue to refine the dating of these types (e.g., Miller 1991:5-11), our ability to estimate site occupation spans will improve accordingly.

It is also important to reiterate that our dating methods should be applied only to assemblages that can reasonably be assumed to represent single, continuous occupations. Multicomponent sites or assemblages contaminated by postdepositional mixture will generally yield erroneous estimates. Obviously, this places a burden on the analyst to screen out such cases, a process made more difficult by the fact that one would only consider using these methods on assemblages whose dates are not precisely known from documentary sources. In addition to the usual kinds of contextual evidence an archaeologist might employ, the graphs on which our dating methods are based can provide some useful clues in this regard. For example, a gap in the ceramic bar chart—an interval somewhere between the earliest starting date and the latest ending date in which no type occurs—almost certainly indicates a gap in occupation. Similarly, multiple modes (or “peaks”) in the composite ceramic distribution curve might well suggest the presence of multiple occupations. Another circumstance that should evoke caution occurs when one of the boundary percentiles falls outside the plausible range of starting or ending dates. While this circumstance is not necessarily problematic, it might sometimes be caused by a single “stray” sherd—either an heirloom or a postdepositional contaminant—whose presence distorts one or more of the key dates that define the plausible ranges. In such cases it usually makes sense to eliminate the offending sherd and estimate the dates again.

Finally, there is no theoretical reason why the methods described here should be limited in their application to historic sites alone. As chronometric

techniques improve and chronological evidence accumulates, prehistoric phases and ceramic types are being dated with ever more precision. Indeed, chronological discrimination of types and varieties on the order of 50 years or less is becoming increasingly common (e.g., Kintigh 1986). In some parts of North America our chronological resolution within late prehistoric periods is probably sufficient to use these methods productively, especially on sites of longer duration. This potential still remains to be explored.

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