15 Interpreting Radiocarbon Dates

Although stratigraphy and seriation help us date archaeological deposits on an ordinal scale, often this is not enough. Only with an interval time scale can we determine the duration of an archaeological occupation or be confident that occupation at two different sites was contemporaneous. For sites of the last 50,000 years or so, radiocarbon dating is the method of choice for dating archaeological events on an interval scale.

This chapter will not review the physical principles behind radiocarbon dating, which are relatively well known and appear elsewhere (e.g., Aitken, 1990; Bowman, 1990; Taylor, 1987). Instead, it will concentrate on how to interpret and apply radiocarbon results.

Sometimes archaeologists have misunderstood radiocarbon dates, simply rejecting dates that do not agree with their preconceptions, or even rejecting the radiocarbon method altogether. Appropriate use of radiocarbon dates reflects the fact that they are statistical estimates, that "radiocarbon years" are not the same as calendar years, that calibration of radiocarbon dates can either decrease, or *increase,* the precision of date estimates, and that the event that the radiocarbon method dates (the death of an organism or completion of a tree ring) is usually not the same as the event of archaeological interest. Sophisticated use of suites of radiocarbon dates, when informed by stratigraphic and other evidence, can often lead to extremely precise conclusions about the absolute date of archaeological events and the duration of prehistoric processes. But intelligent use of radiocarbon dates, like any dating evidence, requires careful thought about the nature of the events that archaeologists want to date.

Kinds of Dates and Events

Conventionally, archaeologists express dates in distinctly different ways without giving the assumptions behind these dates explicit thought. Sometimes a date can be a point estimate, such as AD 55 or 500 BC, the date expressed as a single year. Note, incidentally, that in the common era, there is no such year as AD 0. The calendar goes straight from 1 BC (or BCE) to AD 1 (or 1 CE). Commonly, archaeologists instead cite a **date range,** such as "fifth century BC" or AD 1150-1300. Sometimes, as happens when we are describing the date of a deposit that is stratigraphically later than a building whose construction date is known, we express the date as a ***terminus post quem***. What we are saying is that the date of interest is *no earlier* than the known date. When citing a date, we could also provide a point estimate and estimated error, such as AD 1050 ± 60. In that case we would be expressing the idea that the most probable date is close to AD 1050, and that the probability declines as we get farther from that date. Most people think that is what happens with a carbon date. As we will see below, however, that is not exactly the case.

We can model the difference between these dates graphically by reference to a probability distribution, or "probability density function," which looks like a histogram. For dates to a single year (assuming we are confident in the date), the probability is 1.0 that the event belongs to that year and 0 that it does not, so the entire area of the distribution is lumped into a single year (figure 15.1 a). For date ranges, we only know the beginning and ending dates and indicate no preference for any particular years in between. Consequently we would model the range with a **uniform distribution** to indicate that every year within the range has an equal probability of being the year in which the event took place (figure 15.1 b). We could model a *terminus post quem* either with a uniform distribution or, to express our belief that a date close to the known date is more probable than a much more recent date, with something like an **exponential distribution** (figure 15.1 c). Note how the probability declines as we move away from the known date. Finally, we could treat a date estimate as the mean of a Gaussian or **normal distribution** (figure 15.1 d)(Buck et al., 1996:97-112; Orton, 1980:100). Other models are also possible (e.g., Bronk Ramsey, 1998a).

In addition, we can expect our date to have one or more sources of bias in addition to and quite different from the statistical error associated with the normal distribution. Most of this bias occurs because the event we actually date is not the event of interest. For example, suppose that the event of interest, or **target event**, is the construction of a room in a Pueblo. We could take a piece of wood used in the construction of the room and date it either by **dendrochronology** or radiocarbon dating. Suppose that we use dendrochronology, because it can give us very precise, point estimates of dates, and the outermost ring of the piece of wood dates to AD 1150. Does this mean that the room was constructed in AD 1150? There are many reasons why it does not. First, even if the outermost tree ring preserved on the wood was the last ring formed before the tree was cut to make timber, the **dated event** (cutting down the tree) is not the same as the target event. For all we know, the tree could have been cut two hours or 200 years before the room was constructed. Jeffrey Dean (1978:229) calls this kind of dating bias a **hiatus** (figure 15.2). Second, the outermost ring may not even be the last ring formed before the tree was cut. Possibly the outer part of the timber was planed down before use, or possibly the outermost rings were burned off in a fire. Dean calls this

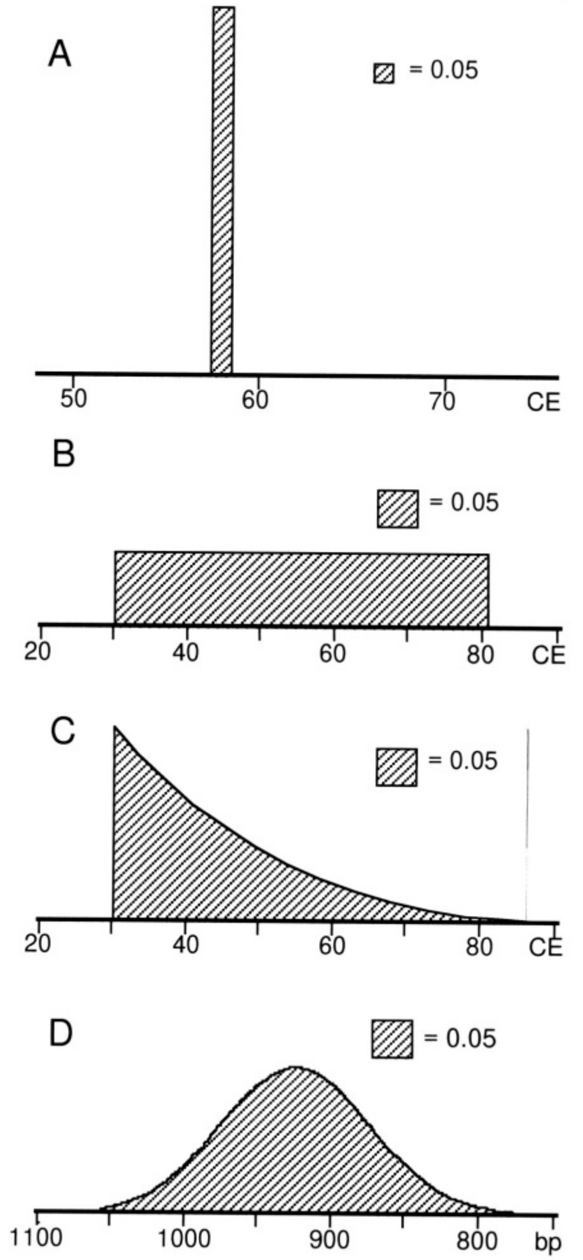

Figure 15.1. Four different models to represent dates. A — a point estimate of AD 58, B — a uniform distribution for the date range AD 30-80, C — a terminus post quem of AD 30, and D — a date of 925 ± 60 bp.