**Supplemental Text 1: Bayesian Analysis and Uninformative Priors**

Inomata et al. (2014) is one of a growing number of studies to employ Bayesian methodologies in the study of archaeological chronology (reviews are available in Bayliss 2015 and Buck and Millard 2004). Quite often it seems as though “Bayesian Analysis” is invoked authoritatively, as though the procedure itself confers legitimacy upon the analysis and guarantees superior results. There is no doubt that Bayesian approaches achieve very solid results when they are properly employed with good data. Nevertheless, they can yield dubious results when data are faulty, or when controls are not present to check the resulting models. Bradley Efron (2013) remarks that, even in statistical journals, the number of articles that use Bayesian analysis inappropriately, by incorporating uninformative prior data, is quite high.

**Big Bayes, Little Bayes**

Bayesian approaches in general seek to use prior knowledge to interpret new results. Thomas Bayes proposed a simple formula by which the probability distributions of new data are modified by utilizing the probabilities estimated by prior studies. Succinctly, “Bayesian methodology quantifies the knowledge accretion process in terms of a blend of prior knowledge concerning a parameter’s density. At the culmination of this process, a modified prior, known as a posterior, is obtained” (Tarter 2000:312).

The goal of Bayesian analysis is to mathematically integrate prior knowledge with new knowledge. That goal is laudable, but the implementation is everything, and you need to know whether the prior information is any good. Efron (2013) described the history of Bayesian analysis: “Twice it has soared to scientific celebrity, twice it has crashed, and it is currently enjoying another boom. The theorem itself is a landmark of logical reasoning and the first serious triumph of statistical inference, yet is still treated with suspicion by most statisticians” (Efron 2013:1177). Efron goes on to say that “Frequentism, the dominant statistical paradigm over the past hundred years, rejects the use of uninformative priors, and in fact does away with prior distributions entirely. In place of past experience, frequentism considers future behavior. An optimal estimator is one that performs best in hypothetical repetitions of the current experiment.” (Efron 2013:1178). Efron concludes: “My own practice is to use Bayesian analysis in the presence of genuine prior information; to use empirical Bayes methods in the parallel cases situation; and otherwise to be cautious when invoking uninformative priors. **In the last case**, **Bayesian calculations cannot be uncritically accepted and should be checked by other methods**, which usually means frequentistically” (Efron 2013:1178, emphasis added).

In some sense, any archaeologist who employs calibrated radiocarbon dates is a Bayesian. Bayesian models were used to formulate the calibration curve and are used throughout programs such as OxCal and BCal. As that may be, a broader interpretation of the Bayesian philosophy (what I call “Big Bayes”) is needed in archaeology. That perspective would bring to bear all informative prior knowledge, not just the posterior probability distribution or distributions of a given assay or a collection of assays. That need is recognized in the works of scholars such as Buck (2004) and Bayliss (2015), who incorporate ‘chronometric hygiene’ and stratigraphic analysis in their models. As the process of building chronology in archaeology depends upon more than radiocarbon dates, defining informative priors needs to consider the strength of the ceramic analysis, the validity of the phase assignment of a given context, and the quality of the stratigraphic relationships.

**Bayes Gone Wild**

Analyzing questionable radiocarbon dates from a time period with a flat calibration curve, from projects lacking refined pottery analysis, and from contexts without good stratigraphic control is likely to yield poor results. In their supplemental materials, Inomata et al. recognize the problems in many of the dates they use, but decide that including them is worthwhile because “Kaminaljuyu demands that researchers respect a greater degree of historical uniqueness of individual features and buildings” (Inomata et al. 2014, supplemental materials, pg. 2). Bad data, even if ‘historically unique’, remain bad data.

Many of the recent dates for the Kaminaljuyu and Naranjo sequences used by Inomata et al. (2014), such as those published by Arroyo (2010), are of unassailable quality, but the dates from older studies are highly suspect. Arroyo’s work at Naranjo and, more recently, Kaminaljuyu, has solid stratigraphic contexts, AMS dates, and high-quality analysis of the pottery. Arroyo’s data are far superior to previous projects at the site in the total array of stratigraphic context, number of high-quality radiocarbon dates, and pottery analysis. Unfortunately, Arroyo’s AMS dates published to date do not include contexts from the critical Verbena and Arenal phases.

Older ceramic data are just as uninformative as older radiocarbon dates because they rely on the presence or absence of a limited range of pottery types or wares. Supplemental Tables 1 and 2 present quantitative data for pottery attributes from El Ujuxte, including vessel forms and decorative motifs, tabulated by stratum. These data show that fine-grained chronologies can be obtained by going beyond presence/absence data and incorporating continuous variables that reflect attribute frequency.

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**Supplemental Text 2: Collapse at 400 cal B.C**.

Inomata et al. describe the decline of Naranjo, ca 400 B.C., as a collapse. Their description of the severity of that event and its consequences, in my opinion, are hyperbolic.

Despite the evidence of change, there is also evidence of substantial continuity that belies the characterization of collapse. A number of secondary centers that erected public mounds (6 m in height and less) during the Las Charcas phase continued to be occupied into Providencia: Virginia, Arcos, Portillo, Charcas, Cieneguilla, and others (Shook 1952). The long, sinuous earthwork known as Montículo de la Culebra at Kaminaljuyu was also begun during the Las Charcas phase with the construction of low clay platforms that included a canal or canals with hydraulic functions. The expansion of La Culebra earthworks continued throughout the Preclassic period with no evidence of disruption (Martínez Hidalgo and Cabrera Morales 1999; Ortega G. 2001; Ortega G. and Ito 2001; Ortega G. et al. 1996).

The practice of erecting stone monuments, especially plain stelae, in the Valley of Guatemala and the Pacific coast region begins in the Middle Preclassic (Las Charcas) and continues smoothly into the Late Preclassic and perhaps beyond (Bove 2011; Guernsey et al. 2010). The carving of representational stelae begins by at least the Providencia phase at Naranjo: although plain monuments dominate the corpus, there are vestiges of low-relief carving on one stela, and three other sculpted monuments may have come from the site (Arroyo 2006:5). Kaminaljuyu Stela 9, the earliest known low-relief sculpture from the site, was found by Edwin Shook in a secure Majadas/Early Providencia phase context (Shook 1951).

The evidence for the supposed collapse at around 400 cal B.C. consists largely in a chronological gap, which I suggest is a product of the flat calibration curve. The simulation byInomata et al. (2014) and presented in Figure 2 of the supplemental data, shows that the flatness of the calibration curve causes dates on either side of 2400 BP to fall earlier or later. Effectively, the period of 600-400 cal B.C. is stretched, and it is difficult to derive a calibrated date with maximum probability within than range. We need to be very careful about interpreting the apparent paucity of sites dating to the period of 600-300 cal B.C.

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