

Socially-inclusive foundations of statistics

Presentation to the Human and Machine Intelligence Group at the University of Virginia

Dan Spitzner, September 9, 2020

Several years ago, I gave a presentation to the Human and Machine Intelligence Group entitled “Why Analyze Data?,” during which I looked beyond the methodology of statistical analysis, toward the diversity of reasons why data are analyzed in the first place, and what the goals are of such analyses. That presentation was my first semi-successful attempt to organize and give form to ideas that had been percolating in my mind for quite a number of years. I have since written a paper (Spitzner, 2020b), soon to be published, that draws from the same inspiration as my previous presentation, but fleshes out its ideas by a different route; it is the basis of my remarks today.

In this work, I explore the phenomenon of alignment between practice and worldview, and the possibility that practices may be realigned. Specifically, my topic is the possibility to detach statistical practice from its traditional pairing with a positivist-type scientific worldview, and to become realigned with a worldview that emphasizes community and social responsibility. In this effort, I am inspired by feminist and decolonization scholars, and others, who criticize the scientific worldview for its emphasis on control and for its exclusionary effects. I am drawn instead to a worldview that underlies “participatory, emancipatory, partnership and user-led research” (Nind, 2014, p. 1), and other approaches that collectively form what has come to be known as socially-inclusive research, whose goals attend to such notions as “unity, cohesion, civic engagement, togetherness, or bridging the gap between ‘us’ and ‘the other’” Koikkalainen (2011, p. 2). My ultimate interest is the development of statistical methodology. To that end, my hope is that this work will ignite creativity, enhance the diversity of people and ideas within my discipline, and open new opportunities for collaboration with other disciplines.

Building on the theme of community, I adopt in this work the perspective that knowledge is made meaningful through a social process. I hope to draw out in this talk the potential of this idea for guiding the development of statistical methodology.

The name I give to this process is “community elicitation.” Here, the term “elicitation” echos a foundational idea in Bayesian analysis, a prominent mode of quantitative inquiry. By that approach, data-analysis is a multi-step process: it begins with a probabilistic statement of what is already known; it then looks to newly-measured data, and applies a mathematical result known as Bayes’s Theorem, to update that knowledge. In this way, Bayesian analysis is a story of transformation: prior knowledge, that gathered at the start of inquiry, is transformed into posterior knowledge.

“Elicitation” refers to the problem of bringing forth knowledge, and it is particularly associated with the elicitation of prior knowledge. A rich set of theories (Savage, 1954) has developed around the elicitation problem, along with a lengthy body of criticism. As it is traditionally conceived, Bayesian elicitation is individualistic in the sense that knowledge is taken to reside in individuals, specifically in the minds of experts. Its accompanying theories borrow heavily from economic abstractions, and carry a strong positivist flavor. In contrast, community elicitation offers an alternative viewpoint by which knowledge resides in community.

These two versions of elicitation contrast in a number of other important ways. For one, they draw support from contrasting perspectives on the nature of human thought (see O’Hagan *et al.*, 2006). Traditional Bayesian methodologists draw particular inspiration from psychological experimentation on human judgement of uncertainty. In the 1970’s, research by Amos Tversky and Daniel Kahneman developed the viewpoint that, when faced with uncertainty, people turn to “approximate strategies that use only limited information” (a.k.a. “heuristics”), and that people’s assessments of uncertainty exhibit “predictable violations of probability theory” (a.k.a., “biases”). This framework is used by Bayesian methodologists to define the goal of elicitation, which is to reduce the “bias” when gathering knowledge from an expert.

In contrast, as support for community elicitation, I look to a 2011 paper by cognitive scientists Hugo Mercier and Dan Sperber who assert an “argumentative” theory of reasoning. This theory posits that “reasoning has evolved and persisted mainly because it makes human communication more effective and advantageous” (Mercier and Sperber, 2011, p. 60). Such a viewpoint contrasts with what these authors describe as the “classical view” that the main function of reasoning is to “enhance individual cognition” (p. 59) and to correct the mistakes of intuition, a view that to me sounds a lot like the heuristics-and-biases framework. Importantly for community elicitation, the argumentative framework strengthens the notion that even isolated individuals are woven into the fabric of community.

Whereas traditional Bayesian elicitation alludes to a process of eliciting knowledge from an expert’s mind, the process of community elicitation plays out as a procession of arguments and counterarguments, accompanied by proposed descriptions of knowledge, all of which move a community toward a larger description of what it knows. Methodologically, the goal of an individual researcher is to formulate an argument in support of a proposed description of knowledge, which could rest on sources other than experts, such as existing literature, and would acknowledge a range of influences from the researcher’s community.

The distinct process and goals of community elicitation, as well as its broader scope, stands to offer new and potentially helpful perspectives around longstanding debates around probability and prior knowledge (see Oakley and O’Hagan, 2007 and sec. 5.2 of Garthwaite, Kadane, and O’Hagan, 2005). It does not demand an entirely new methodology built from scratch, but instead motivates a reexamination and potential repurposing of traditional Bayesianism’s already extensive toolkit for elicitation (see Garthwaite, Kadane, and O’Hagan, 2005). It seems to be a promising idea.

I return, now, to my questions around the alignment of practice and worldview. These questions are, for me, manifestations of deeper, personal wonderings from my journey as a statistician. My overarching interest is in the problem of statistical inference, which I would define today as the problem of making *meaning* out of numerical data.

What I have come to learn about this problem is that traditional Bayesian reasoning is regarded as a normative theory of statistical inference, by which I mean to say that it passes a standard of rationality that qualifies it as a theory that “should”—I write that in quotes—guide statistical practice (see Howson and Urbach, 1989, sec. 3.c). However, statistical practice, especially in the United States, is dominated by an alternative mode of inferential thinking, known as the frequentist approach (see Mayo, 2005). As a framework for statistical inference, frequentism is well known to exhibit logical flaws (see Berger and Wolpert, 1988), but it is nevertheless embraced for reasons that I interpret as its consistency with the view

of an inherent order within nature, or perhaps it is embraced out of pragmatism, a topic that I touch on later. Further complicating the picture, Bayesian methodologists have put forward analytically-derived representations of prior knowledge that are purported to allow bypassing of the elicitation problem, and in doing so incorporate traditional notions of objectivity into the Bayesian machinery (see Consonni, Fouskakis, Liseo, and Ntzoufras 2018 for a review). These methods have become enormously popular within Bayesian statistics, despite accompanying theory that establishes such so-called objective Bayesian methods induce logical inconsistency, and negate Bayesianism’s claim to provide a normative theory (see Berger, 2006, sec. 3.3).

What I gather from this situation is that mathematical reasoning does not drive current-day statistical practice. Instead, statistical practice is aligned with a positivist-type scientific worldview, whose tenets dictate what lines of supporting mathematical formulation are allowed to flourish.

The question that I ask is whether this alignment is the only one possible. That is, it is possible to develop a sensible supporting formulation of statistical practice under the guidance of an alternative worldview? Or, to state the question critically, must it be the case that the only statistical methodology available, the only methodology that filters into our classrooms and training workshops, that is built into our statistical software packages, and that influences the conventions of research, is methodology that developed under the guidance of a worldview that is noted for social irresponsibility?

These questions have to do with the shaping of statistical practice, and to address them earnestly I have begun a project with practically-minded goals. As a first step, I have sought to identify communities of researchers who seemingly implement statistical practice under a socially-inclusive worldview. This has led me to become intrigued by mixed methods research, an approach that embraces intersection between qualitative and quantitative methodologies. The mixed-methodologist Jennifer Greene describes it as a form of inquiry that “actively invites [us] to participate in dialogue... multiple ways of seeing and hearing, multiple ways of making sense of the social world, and multiple standpoints on what is important and to be valued and cherished” (Greene, 2007, p. 20). Due partly to the influence of qualitative perspectives, this way of doing research is sometimes practiced under a socially-inclusive worldview.

The discussions around mixed methods research are additionally interesting for addressing interpretive tensions that arise when attempting to co-mingle qualitative and quantitative methodologies. Within this debate, three positions draw notable attention: number one, incompatibility, the view that qualitative and quantitative methods are inherently incompatible and cannot be integrated; number two, the dialectical position, the view that qualitative and quantitative approaches can be put into dialogue while respecting their interpretive distinctions; and, number three, integration under cover of pragmatism (see Meixner and Hathcoat, 2018, sec. 2.2).

Among these, the pragmatist position is the one most widely adopted; its effects are worthy of closer examination. The particular flavor of pragmatism that is commonly adopted emphasizes expediency; it falls short of informing substantial decisions made during the course of research (see Hathcoat and Meixner, 2017), and is problematic for ostensibly hindering the extent to which mixed methods studies integrate their constituent methodologies. Scholars have noted a common inclination for researchers to adopt a pragmatist stance not

to deepen understanding or to harness the “best of both worlds,” as has been touted as an advantage of mixed methods research, but to “secure funding for their research interests and publish their findings” (Bryman, 2007, p. 17). Others have noted that the rise of mixed methods research has marginalized qualitative research, while an effect of lack of integration having become accepted is that a majority of mixed methods studies “use the analytic and prescriptive style of positivism” (Giddings, 2006, p. 200).

Given this situation, my hope is that realigning statistical practice would enable greater integration in mixed methods studies, and consequently, greater ease at which such studies may be practiced as socially-inclusive research. As an alternative to the incompatibility, dialectical, and pragmatist positions, I propose a fourth option, which is to translate the aims of qualitative perspectives into a vision for socially-inclusive foundations for statistics. In other words, as strange as this may sound, the aim is to develop a class of statistical methodology that is customized for a qualitative mindset.

The blueprint I offer is Bayesian statistics applied using community elicitation. Community elicitation is attractive to this context for reasons that I have already discussed. As for the Bayesian framework, I find that its emphasis on prior knowledge forms a bridge to qualitative methodologies through the latter’s typical emphasis on positionality within the research context. For example, it would matter to context whether a health sciences study, say, aims to clarify aspects of a biomedical model, or if its immediate applications are to clinical care. Noting these differences gives rise to questions about how the two positions interface in society, and shifts perspective to a deeper level of meaning. When viewed as part of the larger task of compiling background information, gathering prior knowledge and uncovering positionality hold potential to inform each other, and to set up a seamless integration of methodology.

A second aspect of the methodology I envision is that it would use a revised form of statistical reporting that would avoid probabilistic abstractions that cast inquiry as a game of chance. To this end, I have written a separate paper on a reporting scheme that I call “pool reduction” (Spitzner, 2020a). This formalizes an idea expressed in the law literature on evidence-reporting. It is suitable for contexts where one would normally think to report a p-value, or a Bayesian version of one. In a 2018 paper (Thompson, 2018, sec. III.C), the law scholar Bill Thompson illustrates the scheme’s basic reasoning by asking the reader to consider a DNA profile that “would be found in only one person in 1 million in the general population;” he points out that “in a nation as large as the United States there are likely to be over 300 people who share the one-in-a-million DNA profile;” it follows that any further reduction in the pool of potential DNA sources, from 300 down to one, would be determined by considerations beyond the material examined in forensic analysis. A point to contemplate from this is example is that reporting “one-in-a-million” odds is abstract and easily made meaningless, while reporting in terms of pool reduction reminds the reader of the responsibilities of decision-making and the actual stakes of inquiry.

The success of the project I have started will ultimately be measured by the extent to which the methodology I envision is used and found to be helpful within socially-inclusive research. That remains to be seen. In the meantime, I aim to improve ease-of-access to Bayesian methodology, especially to lower-level methods that would be used routinely, and also advanced techniques that would be applied in consultation with a statistician. I aim further to promote effective dialogue that would clarify a qualitative understanding of statistical

methodology, and work toward collaborations that would manifest holistic understanding within a research team, as well as showcase the effectiveness of community elicitation. My hope is to offer those who practice under a socially-inclusive worldview the opportunity to be discerning about the choice of statistical methodology, and provide an option that would align with their research perspectives.

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