INTRODUCING THE SPECIAL ISSUE ON INFORMAL INFERENTIAL REASONING

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Inference is a foundational area in statistics, and learning and teaching about inference is a key concern of statistics education. The aim of this special issue is to advance the current state of research-based knowledge about the development, learning, and teaching of a critical subset of issues in this broad area; we focus on ***informal*** aspects of inferential reasoning. This topic was the focus of the Fifth International Forum on Statistical Reasoning, Thinking and Literacy, held at the University of Warwick, UK, in August 2007, and a number of the papers in this Special Issue have been developed from papers presented at that conference.

In selecting papers for the special issue, we have aimed to focus on learners' informal ideas about statistical inference or on people's intuitive ways of reasoning about statistical inference in diverse contexts rather than on mastery of formal procedures or methods. The first paper, by Allan Rossman, introduces the topic by setting out a statistician's view of the roots of statistical inference, emphasizing how those roots might be addressed by informal methods at the tertiary level. Although such approaches have relevance to secondary teaching, the intention is to provide a basis for the meaningful development of formal ideas. Subsequent papers in this special issue consider epistemological, psychological, and pedagogical dimensions that underpin informal inferential reasoning at all phases of education and beyond.

We recognize at the outset that the definition of what counts as "informal inference" is slippery: What is informal could depend on the nature of the inferential tasks being studied, on the complexity of the statistical or probabilistic concepts involved, on the educational stage, and on other factors. We see the two papers which follow Rossman's as framing the remainder of the special issue. Beyth-Marom, Fidler, and Cumming propose the term, *statistical cognition*, to unify the enterprise of mounting evidence across what have traditionally been the disparate disciplines of statisticians, psychologists, and educators. Zeiffler, Garfield, delMas, and Reading seek to build a working definition of informal inferential reasoning as *the way in which students use their informal statistical knowledge to make arguments to support inferences about unknown populations based on observed samples.* Starting from this definition, the authors offer a framework for designing tasks for its study.

The remaining papers do indeed provide data that we might view as the starting point of such research and the reader might wish to consider these papers in the light of the framework proposed by Zeiffler et al. One might ask whether it is possible to locate these four studies in that framework or indeed whether the papers throw light upon the validity

Statistics Education Research Journal, 7(2), 3-4, http://www.stat.auckland.ac.nz/serj

or scope of the framework itself. At the same time, it is appropriate to ask whether such evidence supports the notion of *statistical cognition* as proposed by Beyth-Marom et al.

For example, Watson examines the informal inferential reasoning of 12- to 13-year-olds using *Tinkerplots*™. One claim in the paper is that the ease of creating representations in *TinkerPlots* may contribute to the students' developing intuitions about what might be considered as a *real* difference when comparing data sets. Paparistodemou and Meletiou-Mavrotheris also report on a classroom-based study involving *Tinkerplots*, though in their case at the younger age of 8 years. In support of the claim by Watson, they argue that the dynamic statistical software, in the context of carefully-focused questioning by the teacher, facilitated informal inferential reasoning. In both these papers the interactions between the design of tasks, the teacher's role, the functionality of the software, and children's ownership of the data are explored and discussed. In terms of the Beyth-Marom analysis, both provide evidence in relation to statistical cognition, and, with respect to Zeiffler et al., both respond to their call for "more research to explore the role of foundational concepts, data sets and problem contexts, and technology tools in helping students to reason informally, and then formally, about statistical inference."

The paper by Pratt, Johnston-Wilder, Ainley, and Mason extends the discussion to the context of probability and the responses of 10- to 11-year-olds to dice-throwing tasks. By drawing on Mason's theory of the Structure of Attention, the analysis provides a micro-level analysis of children's inferential reasoning. Whereas Watson and Paparistodemou and Meletiou-Mavrotheris explore students' inferential reasoning about survey data, Pratt et al. consider informal inferential reasoning when the data are generated by a die. As statisticians, we might think of the die's generational capacity as an instantiation of a theoretical uniform distribution. In comparing these three papers, we might ask how students' inferential reasoning is shaped by such a fundamental difference in the statistical structure of the task, the nature of the distribution as a collection of data, or as a theoretical potential.

In the final paper, Bakker, Kent, Derry, Noss, and Hoyles remind us that informal inferential reasoning is not the sole prerogative of education in school and college. They consider statistical process control in automotive manufacturing. The paper helps us to recognize the breadth of the notion of informal inferential reasoning, not only in terms of the age and context of the learners but also in terms of its epistemological location. Bakker et al. highlight the need to foreground the goals within the settings that structure the reasoning activity.

The collection of papers in this special issue illustrates then the importance of the topic. Research in this field, although still in its infancy, begins to offer insights into learners' inferential reasoning and how that thinking might be shaped more effectively by well-designed tasks. We see how inferential activity takes place at all ages and is important in itself and as a meaningful basis for a more formal treatment in later schooling. The issue as a whole points to the differing positions that future research on this topic might take: a developmental position in which learning can be assessed against an emerging framework; a micro-level position that focuses on students' inferential reasoning as it changes in the moment; an inferentialist position in which goals are related to the space of reasons within the setting.