Towards more accessible conceptions of statistical inference

C. J. Wild, M. Pfannkuch and M. Regan (*University of Auckland, New Zealand)* and N. J. Horton (*Smith College, Northampton, USA*)

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Summary. There is a compelling case, based on research in statistics education, for first courses in statistical inference to be underpinned by a staged development path. Preferably over a number of years, students should begin working with precursor forms of statistical inference, much earlier than they now do. A side benefit is giving younger students more straightforward and more satisfying ways of answering interesting real world questions. We discuss the issues that are involved in formulating precursor versions of inference and then present some specific and highly visual proposals. These build on novel ways of experiencing sampling variation and have intuitive connections to the standard formal methods of making inferences in first university courses in statistics. Our proposal uses visual comparisons to enable the inferential step to be made without taking the eyes off relevant graphs of the data. This allows the time and conceptual distances between questions, data and conclusions to be minimized, so that the most critical linkages can be made. Our approach was devised for use in high schools but is also relevant to adult education and some introductory tertiary courses.

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COMMENTS:

Milo Schield *(Augsburg College, Minneapolis)*
At the 1995 meeting of the American Statistical Association in Orlando, Robert Hogg talked extemporaneously about problems in teaching the introductory statistics course. I can still hear his voice saying none too quietly,

> 'I'm tired of people talking about problems in the introductory course. I know there are problems. I've written about some of the problems. What I want is for someone to come up with a solution: a comprehensive solution: not just a small change. I want them to write up their solution in detail so I can see what to do differently. I want to be able to try it for myself. Then I will know how good it is'.

Bob Hogg was very perceptive. It is much easier to be a critic than a creator.

The Wild-Pfannkuch-Regan-Horton paper is all but certain to satisfy Bob Hogg's requirements. This paper does not just dwell on the problems; it advocates solutions; solutions that involve greater fcous on ideas and concepts, less focus on the numerical details. And the solutions are detailed-not just broad generalizations; they form an integrated whole-not just a narrow change. Although some elements of this paper have been presented and discussed at various conferences (Statistical Reasoning, Thinking and Literacy, the International Conference on Teaching Statistics, the International Statistical Institute, American Statistical Association, etc.) by the co-authors and others, this paper integrates these ideas into unified plan based on visual evidence.

The metaphors presenting these ideas are vivid and compelling:

- 'our scene setting metaphor for statistical inference starts with the idea that looking at the world by using data is like looking through a window with ripples in the glass';
- 'we limit attention to distortions that are produced by the act of sampling and sampling variation'.

The central issue and the author's key claim are presented in a straightforward way:

- 'some statisticians may be uncomfortable about using the non-overlap of individual uncertainty intervals to indicate [statistical] significance'; 'we believe that this is a finer-distinction, later-refinement issue rather than a fundamental issue';
- 'each [of our guidelines] is statistically valid but with a limited range of applicability'.

In conclusion, if the goal is to introduce the idea of statistical inference to statistical beginners without the use of computational aids and with minimal mathematics, then arguably this paper represents the single biggest advance in several decades of concerted effort in statistical education.