

Principles of Statistical Inference

Nancy Reid

University of Toronto, Toronto Canada reid@utstat.utoronto.ca

David Cox

Nuffield College, Oxford UK david.cox@nuffield.ox.ac.uk

Statistical theory provides a foundation for studying the collection and interpretation of data that does not depend on the particular details of the substantive field in which the data is being considered. This serves to provide a systematic way of approaching new problems, and to give a common language for summarizing results; ideally this foundation and common language ensures that the statistical aspects of one study or of several studies on closely related phenomena can, in broad terms, be readily understood by the non-specialist. For example, the notion that the median is a better summary of income-related data seems to have gained rather general acceptance in the media. As another example, the widespread insistence on p -values for reporting results in medical journals provides a certain uniformity to the presentation, even if this is less than satisfactory as a blanket prescription.

However, the continuing distinction between Bayesian and frequentist approaches to data analysis, and sometimes between “Bayesians” and “frequentists”, is a source of ambiguity and potential confusion outside, and perhaps inside, the discipline of statistics. We will aim to discuss some principles of statistical inference, to outline how these are, or could be, used to inform the interpretation of results, and to provide a greater degree of coherence for the foundations of statistics.

Key Words: Bayesian, empirical Bayes, statistical theory, frequentist, likelihood