TEACHING OF STATISTICS IN THE HEALTH SCIENCES

Section of the American Statistical Association

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EDITOR'S NOTES

With the thought of a new year just around the corner, it seemed appropriate to think about what this newsletter could offer in 1994. One of our goals is to disseminate information about statistics to those interested in teaching in the health sciences as well as other disciplines. This leads me to think about new innovations as well as areas that are apparently lacking in teaching statistics. The two articles in this newsletter may help to open lines of communication that could only benefit those who are interested. The emergence of a truly electronic journal dedicated to teaching statistics is almost a necessity if we are to compete in the new world marketplace. I would like to thank E. Jacquelin Dietz and the many unnamed associates at North Carolina State University who helped get the journal off the ground. However, I would also like to suggest that "we" have let an area of statistics fade off into the sunset; that of the philosophy of science. I would like to thank Richard Ittenbach and Linda Swindell for jump starting us with a paper on empiricism. Obviously, there are many areas for further discussions, and with over 700 subscribers, the newsletter is ready for opinions.

Happy Holidays,

Steve Verhulst

Empiricism and Early Scientific Thought

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Students of the liberal arts are routinely introduced to the philosophies of Socrates, Plato, and Aristotle. Students of the sciences often learn of the contributions of the early empiricists, Hobbes and Bacon, and of their successors, Locke, Berkeley, and Hume. The tradition of the empiricists, with its adoption of the inductive method and its reliance on sense observation, represents a point of philosophical convergence for many of the sciences today. Unfortunately, students of statistics often receive little or no formal instruction linking philosophical traditions to the discipline of statistics. This void is easily understood as the contributions of philosophy to statistics and research are frequently treated with fleeting references or are offered in a sporadic or disorganized manner.

Unless the instructor has a particular interest in the history of statistics, the evolution of science, or the contributions of technology to western civilization, the student may be left with the notion that philosophy has contributed little to the discipline of statistics. If statistics is the product of the empiricists' method of observation and the mathematician's procedures for numerical analysis, then it seems prudent that students of statistics be offered a systematic introduction to early philosophical positions such as empiricism. The purpose of this paper, then, is to offer statistics instructors insight into the earliest evolutionary stages of scientific thought, the ideas of the Pre-Socratics, and possible relationships with empiricism. The following discussion is presented according to three themes commonly associated with the early thinkers: conceptions of reality, pursuit of truth, and the birth of scientific reason.

Conceptions of Reality

Few topics define the early Pre-Socratics as much as their quest to understand reality. For some, reality consisted of a single, underlying substance (monism). For others, reality was comprised of multiple factors (pluralism). In some cases, the multiple factors were physical and in others they were abstract. While Locke (1632-1704) struggled with the reality of something as simple as an apple and its many characteristics (e.g., redness, roundness), the Pre-Socratics had to first come to terms with the very essence of reality. For Thales (approx. 600 B.C.) there was one underlying factor to all things in the universe, water. For Anaximenes (approx. 545 B.C.) it was air, for Heraclitus (approx. 500 B.C.) it was fire; for Empedocles (approx. 450 B.C.), a pluralist, it was earth, air, fire, and water. For Pythagoras (approx. 515 B.C.), however, numbers were the basis of all reality. Consequently, one of the strongest links between empiricism and early Greek thought lies in the early work of Pythagoras and the belief that all things in the universe could be explained in terms of numbers and numerical relationships. Though far from science as practiced today, the Pythagoreans are credited by Cornford (1991) with beginning the process of intellectualizing mysticism and of freeing the intellect to mathematically scrutinize the workings of the universe. As Mason (1962) has suggested, "The Pythagoreans removed the gods from nature" (p. 26). The Pythagorean Theorem is one example of this enduring influence.

The Pre-Socratics' understanding of reality was not, however, limited to mere observation. As early as 500 B.C., Greek theorists recognized a difference between static and changing events. Increasing the complexity of the issue further was the belief that some things that were indeed real were not observable, as with Anixamander's Apeiro. If differences between the real and the unreal (or the observable and the unobservable) were difficult for the post-Renaissance empiricists, they were exceedingly difficult for their ancient predecessors, the Pre-Socratics. Parmenides (approx. 475 B.C.), made a clear distinction between the real and nonreal, and chose to articulate this dilemma in terms of truth and nontruth. That is, reality was the basis of truth while nonreality was the basis of mere opinion. For Parmenides as well as Xenophanes (525 B.C.), sense experiences were relative and any information obtained by them must at some point yield to truth (Stumpf, 1988).

Pursuit of Truth

The Pre-Socratics' efforts to conceptualize reality using observable rather than mythological phenomena constituted the beginning of a disciplined quest for truth. For many of the budding empiricists, an ordered universe was one with laws that were both observable and interpretable, and one in which truth was synonymous with the natural laws of universe operations. In fact, while their contributions to science were not sophisticated, their tenets were foundational for relating particular and observable instances of reality to general laws of universal functioning (Grant, 1991, p. 15).

Embedded within the concept of universal laws is the notion of truth. The Pre-Socratics' search for truth was a quest for lawful (true) principles. Well before Hume's (1711-1776) attempts to distinguish analytic from synthetic truths, Xenophanes, Pythagoras, and Heraclitus struggled to understand the order of the universe. However, it is Democritus' (approx. 400 B.C.) acceptance of two types of knowledge: objective (trueborn) and subjective (bastard), that makes the pursuit of the concept of truth more likely for later scientists. While sensory experience is indeed subjective and offers only appearances, reason has no tools with which to work without input from the senses (Lawhead, 1993). In short, reason must rely on the senses and sensory input to assimilate and process information.

Seventeenth century philosophers such as Berkeley (1685-1753) and Locke believed that all knowledge traced back to one's experiences, but early Greek philosophers such as Anaximander and Anaximenes were not so certain. Anaximander, for instance, believed that the basic substance of reality, Apeiron, could not be seen or felt--but was indeed real. Xenophanes and Heraclitus were equally uncertain about the role of the senses. For Xenophanes, not all truths were knowable. For Heraclitus, there was but one truth on any particular issue. Although he believed that there was a rational order available for human understanding, most people preferred to trust their own opinions instead (Lawhead, 1993). According to Grant (1991), it is precisely the early philosophers' efforts at applying conditional criteria to everyday occurrences that places them at the foot of the trail of modern science.

Birth of Scientific Reason

Locke (1632-1704) is often cited as an early leader of the empiricism movement. Two tenets of Locke's work are most useful for the statistics instructor: (a) that one could only reason from experience and (b) that an orderly and systematic scientific method is achievable. Not lost on Locke was the realization that it is was Anaximenes who was responsible for the first scientific experiment of recorded history. However, Anaximenes' activities represent more than just a simple experiment of the expansion and contraction of air and its relationship to heat. Anaximenes' experiment manifested a belief that quantitative changes in performance were required to produce qualitative changes in an event (Lawhead, 1993), a position that empiricists worldwide would later adopt.

While Pythagoras and the Pythagoreans are credited with setting the stage for the union of mathematics and scientific thought (Dampier, 1948), two other events stand out as prominent influences of the early empiricism movement. First, is Democritus' explanation of the mechanics of nature--that reality was more a function of matter than of mind. This was carried forward well beyond the era of Newtonian physics. A second major event resulted from the activities of early Greek physicians who held a mechanistic view of the human body. That is, they found that not only was the human body comprised of systems and subsystems but that naturally occurring events could be thwarted by a priori involvement on the part of the physician, thereby providing medical sciences' forerunner of cause-and-effect relationships (cf. Hippocrates; Dampier, 1948). Most contemporary empiricists would recognize Hume's principles of association (resemblance, contiguity, cause and effect). Indeed, Hume himself considered his description of cause and effect to be the central tenet of his theory on the acquisition of knowledge (Stumpf, 1988). It is in this particular principle that one can see his affinity for the scientific method and his willingness to apply it to the acquisition of ideas. Yet even this position is not without precedent. One such example lies in the work of Empedocles and his effort to explain how things changed both in form and movement. Empedocles actually designated two forces, love and hate, that were responsible for causing all change. That is, he believed that love represented positive forces that caused the elements (i.e., earth, air, fire, water) to draw together in various forms while hate represented negative forces that caused the four elements to decompose or move apart (Lawhead, in press; Stumpf, 1988). As founder of the Italian school of medicine, Empedocles transferred his knowledge of and belief in multiple causative factors to the human body. According to Russell (1972), Empedocles was part prophet, part philosopher, and part man of science.

The purpose of this paper was to offer statistics instructors insight into the earliest evolutionary stages of scientific thought, the ideas of the Pre-Socratics, and possible relationships with empiricism. Ideas considered essential to the field of statistics were presented, from conceptions of reality to the pursuit of truth, to the birth of scientific reason. Later philosophers would extend their efforts at exploring and refining these basic tenets. Developing quietly from within and across the sciences are many philosophical positions used to push statistics forward, methods that are as much a function of the

Pre-Socratic philosophers as the more frequently cited empiricists.

References

Cornford, F. M. (1991). From religion to philosophy: A study in the origins of western speculation. Princeton, NJ: Princeton University Press.

Dampier, W. C. (1948). A history of science: And its relations with philosophy & religion (4th ed.). New York: Cambridge University Press.

Grant, M. (1991). The founders of the western world: A history of Greece and Rome. New York: Scribners.

Lawhead, W. F. (1993). Unpublished document. Oxford, MS: Author.

Mason, S. F. (1962). A history of the sciences. New York: Macmillan.

Russell, B. (1972). A history of western philosophy. New York: Touchstone.

Stumpf, S. E. (1988). Philosophy: History & problems (4th ed.). New York: McGraw-Hill.

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THE JOURNAL OF STATISTICS EDUCATION

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The Journal of Statistics Education (JSE) is a new rigorously-refereed electronic journal on postsecondary statistics education. JSE publishes high-quality articles on a variety of topics related to the teaching of statistics, for instance, results of controlled experiments on pedagogical methods, case studies and anecdotal reports, review and opinion articles, and discussion of the impact of new technologies and new methods of assessment on statistics education. Articles that make innovative use of the electronic medium are encouraged.

Journal departments include "Teaching Bits: A Resource for Teachers of Statistics," briefly summarizing pertinent items published elsewhere, "Reviews" of software, books, and teaching materials, and "Data Sets and Stories," providing data sets and contexts useful in teaching. We intend JSE reviews to be descriptions of an instructor's experiences actually using a particular book or piece of software with students. The "Data Sets and Stories" department not only identifies interesting data sets and describes their useful pedagogical features, but enables instructors to download the data sets to their own computers for further analysis or dissemination to students.

The first issue of JSE appeared in July 1993. It contained a discussion on statistics education by David Moore and Frederick Mosteller, a conference report on curricular reform in statistics by George Cobb, an article on teaching statistics using cooperative learning groups by Joan Garfield, a downloadable dataset with ideas for class use by Robin Lock, an article on the structure and philosophy of the JSE by Tim Arnold, and more. The table of contents for the first issue can be obtained by sending e-mail to archive@jse.stat.ncsu.edu with the one-line message: send jse/v1n1/contents.

The decision to make the journal an electronic one carries benefits that extend beyond the obvious ones of saving paper and printing costs and shortening the time lag associated with publishing in print journals. The electronic medium offers opportunities that do not exist with paper journals. Eventually we will be able to include dynamic and/or interactive graphics, sound, or even video clips in an article. Downloadable data sets, a parallel discussion list, and the capability to query the entire archived journal are unique features of the electronic medium.

PERSONNEL AND SUPPORT

Current personnel for the Journal of Statistics Education include an Editor, Jacquelin Dietz, and a Managing Editor with responsibility for the technical/electronic areas, Tim Arnold. Joan Garfield and Laurie Snell are the editors of the Teaching Bits department, and Robin Lock and Tim Arnold are the editors of the Data Sets and Stories department. There is an international Editorial Board of 25 whose members serve as referees for submitted manuscripts.

Articles submitted to the journal are reviewed by three referees. Two referees are members of the Editorial Board; the third is chosen from a pool of volunteer referees. Readers interested in becoming JSE referees are encouraged to contact me at dietz@stat.ncsu.edu. Refereeing is double-blind.

The Section on Statistical Education of the ASA has endorsed the establishment of JSE. The Executive Committee of the Section has agreed to serve as an Advisory Board to the journal and as a search committee at times of editorial succession. The JSE is supported by the Department of Statistics at North Carolina State University and by a grant from FIPSE, the Fund for the Improvement of Postsecondary Education, U.S Department of Education.

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Submission of manuscripts via e-mail is preferred, but materials on diskette or paper can be accommodated. The electronic format of the journal requires that articles follow certain formatting conventions; consult the Guidelines for Authors before submitting materials to JSE. The Guidelines for Authors may be obtained by sending e-mail to archive@jse.stat.ncsu.edu with the one-line message: send jse/author.guide. Guidelines for submitting datasets to the JSE data archive may be obtained by sending e-mail to archive@jse.stat.ncsu.edu with the one-line message: send jse/datasets.guide.

I welcome ideas and comments concerning the journal; I can be reached by e-mail at dietz@stat.ncsu.edu, by phone at (919) 515-1929, by FAX at (919) 515-7591, or by mail at Department of Statistics, Box 8203, North Carolina State University, Raleigh, NC 27695-8203.

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This newsletter will publish official notices, articles, book reviews, descriptions of research in progress, reviews of research, letters, and announcements judged to be of interest to members of the subsection. Materials and manuscripts should be submitted to:

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