ERROR AND INFERENCE

Although both philosophers and scientists are interested in ways to obtain reliable knowledge in the face of error, a gap between their perspectives has been an obstacle to progress. Through a series of exchanges between the editors and leaders in philosophy of science, statistics, and economics, this volume offers a cumulative introduction that connects problems of traditional philosophy of science to problems of inference in statistical and empirical modeling practice. Philosophers of science and scientific practitioners are challenged to reevaluate the assumptions of their own theories – philosophical or methodological. Practitioners may better appreciate the foundational issues around which their questions revolve, thereby becoming better "applied philosophers." Conversely, new avenues emerge for finally solving recalcitrant philosophical problems of induction, explanation, and theory testing.

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Recent Exchanges on Experimental Reasoning, Reliability, and the Objectivity and Rationality of Science

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To George W. Chatfield

For his magnificent support of reseacrch on E.R.R.O.R. in science

Contents

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Preface

A central question of interest to both scientists and philosophers of science is, *How can we obtain reliable knowledge about the world in the face of error, uncertainty, and limited data*? The philosopher tackling this question considers a host of general problems: *What makes an inquiry scientific? When are we warranted in generalizing from data? Are there uniform patterns of reasoning for inductive inference or explanation? What is the role of probability in uncertain inference?* Scientific practitioners, by and large, just get on with the job, with a handful of favored methods and well-honed rules of proceeding. They may seek general principles, but largely they take for granted that their methods "work" and have little patience for unresolved questions of "whether the sun will rise tomorrow" or "whether the possibility of an evil demon giving us sensations of the real world should make skeptics of us all." Still, in their own problems of method, and clearly in the cluster of courses under various headings related to "scientific research methods," practitioners are confronted with basic questions of scientific inquiry that are analogous to those of the philosopher.

Nevertheless, there are several reasons for a gap between work in philosophy of science and foundational problems in methodological practice. First, philosophers of science tend to look retrospectively at full-blown theories from the historical record, whereas work on research methods asks how to set sail on inquiries and pose local questions. Philosophers might ask questions such as "What made it rational to replace the Newtonian theory of gravity with Einstein's General Theory of Relativity (and when)?" But the practitioner asks more localized questions: "Is HIV dormant or active during initial infection? Is the mechanism of Mad Cow Disease and CJD similar to other neurological conditions such as Alzheimer's disease?" Second, philosophers focus on characterizing abstract conceptions of

"*H* is confirmed by evidence ***e***" for a given statement of evidence ***e*** but rarely engage methods actually used to obtain evidence ***e*** in the first place. Where philosophers tend to draw skeptical lessons from the fact that error is always possible, practitioners focus on specific threats that can sully the validity of their evidence and inferences. Third, philosophers of science themselves (at least in the past decade or so) often confess that they have given up on solving traditional philosophical riddles of induction and evidence. But unsolvable riddles, however interesting in their own right, scarcely seem relevant to the practical task of improving method.

Although we grant that, on the one hand, (1) current philosophy of science does not offer solutions to the problems of evidence and inference in scientific practice, at the same time we hold that (2) the resources of philosophy of science offer valuable tools for understanding and advancing solutions to the problems of evidence and inference in practice. These two assertions, however much they may seem to be in tension, we claim, are both true. The first, readily acknowledged in both the philosophy and the science camps, is generally taken as a basis for skepticism about assertion 2. Nevertheless, our experiences in debates about evidence and inference, and about method and statistics in practice, convince us of the truth of assertion 2 – even if the solutions do not have the form originally envisaged. What comes up short in methodological discussions in practice is a genuine comprehension of where the difficulties in solving the traditional philosophical problems lie – the reasons behind assertion 1. In dismissing traditional philosophical problems as esoteric, old-fashioned, or irrelevant, contemporary discussants of methodology may be unable to discern how the very same philosophical issue is, at least implicitly, raising its head in a contemporary methodological debate they care about. Making progress demands a meeting ground wherein the insights of the philosophical and scientific camps can be used to shed light on each other.

To get beyond the current impasse, we proposed to take a significant group of current representatives of philosophical schools and bring the philosophies to life, as it were. Initial dialogues grew into the *Experimental Reasoning, Reliability, Objectivity & Rationality: Induction, Statistics, Modelling* [ERROR 06] conference at Virginia Tech, June 1–5, 2006. Rather than regarding these diverse philosophies as closed "museum pieces," we needed to open them up to peer into them, see where they stand in 2006–2009, and see what perspectives they bring to bear on contemporary problems of modeling and inference.

Doing so, we recognized, required the continuation of the dialogue that we had initiated both before and during the conference. This volume reflects

the results of these exchanges. Its contributions are directed to anyone interested in methodological issues that arise in philosophy of science, statistical sciences, or the social and natural sciences.

Origins of the Contributions to This Volume

The contributions in this volume, in one way or another, touch on issues of error and inference. Mayo's (1996) *Error and the Growth of Experimental Knowledge* (EGEK) provides a launching point or foil for addressing different problems of inference and evidence in the face of uncertainty and errors. The chapters reflect exchanges between the editors and the contributors that began at least two years before the ERROR 06 conference and continued almost that long afterward. Our goal is to highlight developments in the decade following EGEK and to point to open problems for future work. Our strategy required getting contributors, ourselves included, beyond our usual comfort zones. Whereas the Introduction extracts from EGEK by way of background, Mayo's Chapter 1 represents an attempt to move beyond its focus on local experimental tests to take up challenges regarding higher-level theories. Chapter 1 was a fixed target that remained unchanged throughout; however, the editors' reflections in the exchanges shifted and grew, as did the contributions, before arriving at their final form. The contributors were subjected, at times painfully, to our persistent attempts to elucidate positions, decipher disagreements, get beyond misunderstandings, and encourage moves, however small, from initial standpoints. Although open problems clearly remain, we think it is time to stop and take stock of where this dialectic has taken us, indicating where we have inched toward progress, and how we might get around remaining obstacles.

By presenting recent and ongoing exchanges between several representatives of contemporary movements in philosophy of science, statistics, and modeling, we hope to offer the reader glimpses into

- the struggles, arguments, issues, changes, and historical developments behind a cluster of deep and long-standing issues about scientific knowledge and inference, and
- the directions in which future philosophy and methodology of science might move.

Some of the untidiness that remains is instructive of where we have been and where one might go next. The exchanges do not report each stage of the dialogues with contributors, but rather they identify a set of general questions and responses that emerged from the numerous back-and-forth

conversations. By highlighting the multitude of different ways these questions are answered, interpreted, and interrelated, we intend for this volume to offer a cumulative instruction for anyone interested in the philosophical and methodological issues of scientific inquiry.

Acknowledgments

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We wish to acknowledge the many contributions of H. Kyburg Jr. (1927–2007) to philosophy of science and foundations of probability; he was a specially invited speaker to ERROR 06, and we regret that illness prevented him from attending.

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