

John Earman, *Bayes or Bust? A Critical Examination of Bayesian Confirmation Theory*. The MIT Press, Cambridge, Massachusetts, 1992. iv + 272 pp.

Reviewed by

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Bayes or Bust has more than its catchy title to recommend it. This is a thorough, well-written, and even entertaining account of Bayesianism as a comprehensive approach to the confirmation of scientific theories. From my perspective as a Bayesian statistician with limited knowledge of philosophy of science, I have learned a great deal about the foundational issues involved in the study of inductive inference from *Bayes or Bust*. Moreover, the book provides very interesting reading and an excellent source of references through which one could conduct a more extensive study of the field.

Earman's theme is captured in his belief that Bayesianism provides "the best good hope for a comprehensive and unified treatment of induction, confirmation, and scientific inference" (p. xi). While Earman confesses in the introduction that he is a Bayesian, he claims to be so only on certain days of the week (p. 1). This ambiguous attitude permeates the book, for while he extols the virtues of the Bayesian philosophy, Earman does not hesitate in present arguments to which he feels Bayesians have yet in respond satisfactorily. Earman admits that he intends to annoy those on both sides of the Bayesian fence. He charges that "critics of Bayesianism have generally failed to get the proper measure of the doctrine, while the Bayesians themselves have failed to appreciate the pitfalls and limitations of their approach" (p. xi).

The structure of *Bayes or Bust* reflects Earman's self-described "schizophrenia" (p. 2) on the issue of Bayesianism. After the first two chapters present the basic principles of Bayesianism from both historical and modern perspectives, chapters 3 and 4 champion the Bayesian philosophy. Chapters 5-9 then address some thorny problems which

Earman argues that Bayesians have yet in resolve. The concluding chapter provides an entertaining synthesis of the earlier material in the form of a hypothetical conversation about the merits of Bayesianism. The book's structure also contributes much to its readability, for Earman begins and ends each chapter with a concise review of what has come before and preview of what lies ahead.

One distinctive and attractive feature of the book is that it begins at the logical beginning: with an analysis of the Reverend Thomas Bayes' original essay. Earman gives a clear presentation of Bayes' billiard-table model and argues that many modern commentators criticize Bayes unfairly by not appreciating his conception of probability in this context. For example, Earman notes that many have criticized Bayes' use of a uniform prior distribution as an appeal to the oft-maligned principle of insufficient reason. Earman proceeds to argue that Bayes' choice of prior was based not on this principle but on reasonable operational characteristics of the billard-table model.

Earman uses both clever stories and actual scientific theories to illustrate his arguments. An example of the former is his treatment of the "ravens paradox" in chapter 3. This paradox concerns the hypothesis that all ravens are black, and it considers various types of evidence that bear on this hypothesis. To what extent does the observation of a single black raven confirm the theory? What about the observation of a non black, non-raven? Earman's presentation of Bayesian analyses of these and related questions illuminates the issues involved in confirmation theory and the virtues of the Bayesian paradigm. He also contrasts the Bayesian treatment of this problem with notions of qualitative confirmation, particularly the traditional hypotheticodeductive method.

One example of a scientific theory that Earman uses to illustrate several arguments is Einstein's general theory of relativity. In chapter 5 Earman asks the reader to imagine that Einstein has just formulated the final version of his theory and shown that it explains the anomalous perihelion phenomenon of Mercury. The question then is the extent to which the evidence of Mercury's perihelion confirms Einstein's theory. The problem for Bayesians is that since the evidence was already known by scientists of the time, the probability of the evidence is one. Therefore, the posterior probability of the theory given the evidence simply equals the prior probability of the theory, so the evidence provides no confirmatory effect at all. The dilemma is that this conclusion contradicts the widely accepted opinion that the explanation of Mercury's perihelion gives stronger confirmational value to Einstein's theory than other evidence based on novel predictions.

Earman does a commendable job of presenting and then responding to arguments against Bayesianism. He analyzes arguments from scholars such as Hempel, Carnap, Jeffrey, Popper, Glymour, Putnam, and Kuhn. He tackles issues ranging from the largely disrespected method of eliminative deduction, on whose behalf Earman pleads for more appreciation, to the relatively new development of formal learning theory, which he sees as exposing some serious dilemmas for Bayesianism. In some cases Earman presents compelling responses to the objections, in others he argues that Bayesianism presently has no persuasive response. He makes the case throughout, however, that Bayesian confirmation theory "possesses the one unmistakable characteristic of a worthy philosophical doctrine: the harder it is pressed, the more interesting results it yields" (p. 2).

There is one instance in which I feel that Earman dismisses a criticism too lightly. The issue involved is the establishing of causality in light of confounding variables. In chapter 4 Earman addresses the question of whether a Bayesian, upon observing a number of cold-afflicted persons drink coffee daily for two weeks and then recover, would confer a probability greater than .5 to the hypothesis that coffee drinking cures colds (p. 103). Earman's response is to insist that hypotheses be stated precisely in non-causal terms. While one cannot argue with the advice of stating hypotheses precisely, I feel that Earman skirts the critical issue of establishing causality. Another example that seems relevant here is R. A. Fisher's lifelong contention that smoking is not causally related to lung cancer. I would have liked to have seen an analysis of a Bayesian treatment of such a hypothesis.

A nice feature of *Bayes or Bust* is its extensive notes and references. As a novice in this field I find the notes to be valuable sources of information. For instance, Earman begins chapter 3 by describing the hypothetico-deductive method of qualitative confirmation. He notes that its critics "have so battered this account of theory testing that it would be unseemly to administer any further whipping" (p. 63). Despite his polite refusal to indulge in further battering of this theory, Earman kindly provides a note which leads readers unfamiliar with this literature to some relevant references. In fact, the book contains seventeen pages of notes and twelve pages of over 250 references.

Although *Bayes or Bust* contains substantial logical notation, it contains highly technical mathematics in only a few places, primarily in the presentation of Bayesian convergence-to-certainty and merger-of-opinion results in chapter 6. The second chapter of the book does develop probability theory from scratch, but the reader unfamiliar with probability may be in for slow reading. As one should expect from a se-

rious work, of course, the reader must often complete steps in logical arguments for him/herself.

In short, I find *Bayes or Bust* to be a witty and very readable treatment of the important topic of Bayesian confirmation theory. As a novice in this field, I have learned a great deal from the book, but I imagine that the expert would find it just as engaging. Earman's intention is to provoke as well as to inform through this work, and I judge his efforts to have been successful on both counts.

Reflexivity A Source-Book in Self-Reference, edited by Steven J. Bartlett, Amsterdam, North-Holland 1992, XI + 509 pp.

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This book collects together several papers on a phenomenon of reflexivity. The anthology has an introduction by Bartlett and five parts: I. Semantical self-reference (W. V. Quine, 'Paradox'; P. Weiss, 'The Theory of Types'; J. Myhill, 'A system which can define its own truth'; G. Ryle, 'Heterogicality'; J. Jørgensen, 'Some reflections of reflexivity'; R. M. Martin, 'On non-translational semantics'; R. M. Smullyan, 'Languages in which self-reference is possible'; A. N. Prior, 'On a family of paradoxes'; N. Rescher, 'A note on self-referential statements'; R.L. Martin, 'Toward a solution to the Liar Paradox'; B.C. van Fraassen, 'Presupposition, implication, and self-reference'), II. Pragmatical self-reference (D.L. O'Connor, 'Pragmatic Paradoxes'; L.J. Cohen, 'Mr. O'Connor's "Pragmatic paradoxes"'); P. Alexander, 'Pragmatic paradoxes'; A. Duncan-Jones, 'Fugitive propositions'; D. J. O'Connor, 'Pragmatic paradoxes and fugitive propositions'; C. K. Grant, 'Pragmatic implication'; W. D. Hart, 'On self-reference'), III. Metalogical self-reference, F. B. Fitch, 'Self-reference in philosophy'; F. B. Fitch, 'Universal metalanguages for philosophy'; S. J. Bartlett, 'The idea of a