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## Review of Maria Carla Galavotti, "Philosophical Introduction to Probability"

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## **Review of “Philosophical Introduction to Probability” by Maria Carla Galavotti**

CSLI Publications, Stanford, 2005

\$25.00 paperback, 265 pages, including references and index

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### *Introduction*

The philosophy of probability has seen a stable supply of textbooks in the last few decades, dealing with such diverse topics as probability and induction, probabilistic epistemology, interpretations of probability, probability in physics, and the logic of probability. The introduction by Maria Carla Galavotti is a welcome addition to this evergreen field. It covers a wide range of views on the concept of probability, and it approaches them from an original angle, by tracing the history of these views and describing the work of some of their inventors. The result is a book that offers an abundance of accurate information on many of the probabilists, which can serve as a quick historical reference for researchers, and as a general introduction for interested students.

The following presents an overview of the book, as well as a critical discussion of the choices that the author has made in content and presentation. Such criticisms ideally stem from a generic philosopher of probability, but frankly, the criticisms in this review reflect differences that are to be expected between any two individuals working in the philosophy of probability. Moreover, any book of a given length will have to ignore important parts of the literature. It can hardly be held against Galavotti that she has made a number of restrictive choices. The following comments must therefore be taken as indicating the overall outlook of the book, rather than focusing attention on its shortcomings.

### *Overview and discussion*

The book naturally falls into three main parts. First come three introductory chapters on probability, sketching some of its history, providing its laws and axioms, and discussing the classical interpretation. Then come two chapters on objective or physical probability, dealing with the frequentist and propensity interpretation respectively. And finally there are two chapters on probability as an epistemic notion, or a notion pertaining to beliefs, dealing with the logical and subjective interpretation of probability respectively.

Chapter 1 comprises a sketch of the notion of probability, and of its connection to inductive inference. A diverse collection of probabilists is reviewed. In the section on the notion of probability we find Pascal, the brothers Bernoulli, Bayes, Condorcet and Quetelet, Galton and Pearson, and finally Maxwell and Einstein. And in the section on induction we find Bacon, Hume, and finally Mill, Herschel and Whewell. Galavotti gives us a quick run-through, perhaps a bit too quick, to set the stage and to prepare for a more detailed introduction of the concept of probability.

Chapter 2 presents and motivates the laws of probability, introduces Bayesian or inverse probability, and discusses the axiomatisation of probability by Kolmogorov, without going too deeply into its measure theoretic underpinning. Such things as the Popper-Renyi axiomatisation and the issues surrounding countable additivity are mentioned, but not really elaborated on. Chapter 3 consists of an extensive discussion of Laplace's theory of probability, his use of the principle of insufficient reason, and the criticism of this principle originating from Bertrand. The section on Laplace is informative, but to my mind it is an omission that the relation between chance and determinism is not discussed in any systematic sense. Further, in the context of the

principle of indifference I feel that a discussion of entropy maximisation, as advocated by Jaynes and other so-called objective Bayesians, is missing. And finally, Galavotti fails to connect the principle of indifference to the use thereof in the Carnapian tradition in inductive logic. This tradition is discussed later in the book, but the connection with the classical interpretation does not resurface there.

In chapters 4 and 5 Galavotti provides extensive discussions of the frequentist and propensity interpretation of probability. The chapter on frequentism comprises sections on the early frequentists Ellis and Venn, then on Von Mises, and finally on Reichenbach and Nagel. It is nice to find Von Mises, always the central figure of the frequentist view, amongst these other frequentists. The discussion of Reichenbach is particularly interesting in view of the recent developments in probabilistic epistemology, and the discussion of the early English frequentists much more elaborate than I have seen elsewhere. However, with the discussions of Reichenbach and Nagel at the end of the chapter, the frequentist view seems to be associated with an epistemological position, and this takes away from the idea, crucial to frequentism, that probability as frequency is part of the natural world and not of the realm of beliefs. Relatedly, I feel that the chapter could have included sections on statistics and statistical mechanics, since statisticians like Pearson and physicists like Boltzmann have had a marked influence on the development of frequentism.

The chapter on frequentism is followed by a chapter on the propensity interpretation. After identifying Peirce as a precursor, the centre stage of the chapter is reserved for Popper. A third section concerns elaborations and reactions to Popper's theory, dealing with Mellor, Gillies, Fetzer, and Suppes among others. The discussion is fairly comprehensive, but there is unfortunately no attention of Lewis and his principal principle, or of subjectivism and its relation to objectivist chances more generally. Further, while there is some attention for the propensity theory in relation to quantum mechanics and statistical inference, Galavotti does not discuss more advanced aspects thereof, relating to ergodicity, or the diverse problems that we run into when applying propensity theory to quantum mechanics. On the positive side, the chapter ends with an informative and accurate exposition on randomness. From a historical point of view this topic may perhaps be better placed in the chapter on frequentism, but it is wonderful that Galavotti devotes so much attention to this important topic. Moreover, contrary to other textbooks, she does so in accessible and non-technical terms.

The last two chapters, which make up a bit more than one third of the book, deal with probability as an expression of uncertain belief. In chapter 6 Galavotti discusses the logical interpretation of probability. The history of this interpretation is traced all the way from Leibniz via De Morgan, Boole, and Jevons to Keynes, then via Wittgenstein and Waismann to Carnap, and finally to Jeffreys. The discussion is very complete up to 1950, and I was pleasantly surprised by the inclusion of Jevons and Waismann. The only misgiving I have is that the discussion abruptly ends there, leaving out more recent logics of probability, as devised by, for example, Hintikka, Kyburg, Cox, Hacking, Halpern, Paris, and Howson. A further comment is that many subjectivists and Bayesians have claimed to provide probabilistic logics as well, thus muddling the terminology, but Galavotti can certainly not be held responsible for this.

Chapter 7, finally, discusses the subjectivist view on probability. After briefly introducing the mathematicians Donkin and Borel as starting point, the chapter provides an extensive discussion of Ramsey and De Finetti. Galavotti is very well at home in the work of these two authors, and this shows in the many interesting details, both biographical and philosophical, that are provided. A possible drawback of the approach is that the focus on these authors may get in the way of a full understanding of subjectivism as a philosophical position. For example, there is little attention for the development of subjective statistics after De Finetti by Savage, Good, Dawid, and Seidenfeld. Moreover, as Galavotti herself admits, the discussion of Jeffrey and Suppes that completes the chapter is not representative for the turn that subjectivist probability has taken in recent decades. Here van Fraassen, Sober, Bovens and Hartmann, and all those

associated with the budding tradition called probabilistic epistemology are missing. In short, Galavotti provides a very thorough introduction to the roots of subjectivism, but not to its many branches.

### *Probability in the sciences*

By way of conclusion, I want to highlight the characteristics that I find most indicative of the general outlook of the book. But before I do so, let me emphasise that the aspiration of the book is not to defend a specific view on probability, and that if it advocates any such view, it is the pluralistic view advocated by Suppes. From this perspective it is understandable that the book basically consists of a line-up of views, and that there is no attempt to develop a bigger picture from the line-up. On the other hand, the lack of an explicit point of view makes it more difficult to understand why Galavotti has chosen to omit certain parts of the literature.

One such choice is the rather limited space allotted to the statistical tradition, both on the frequentist and on the subjectivist views of probability. The first chapter of the book presents probability and induction alongside each other, which creates the impression that the use of probability in dealing with induction will occupy a central place. But we find very little discussion of the theories of testing by Pearson, Fisher, and Neyman and Pearson after the first chapter. And similarly we find hardly any discussion of Bayesian statistics, its relations to decision theory, and its recent advances in modelling causal relations using Bayesian networks. This is all the more disappointing because the philosophy of probability is, historically at least, intimately connected to philosophy of science, while one of the the main uses of probability in the sciences is statistics.

This leads up to another general comment on the outlook of the book. While the closing remarks put some emphasis on the fact that the philosophy of probability can contribute to a better understanding of the sciences, the role of probability in scientific modelling, quite apart from statistics and its role in methodology, is hardly considered. We learn little about statistical physics, or about probabilistic models in the cognitive and the social sciences. Admittedly, dealing with such advanced topics may require a more mathematical take on the notion of probability itself. And Galavotti remarks in several places that she is avoiding overly technical matters, even if this evasion of mathematical depth means that some insightful systematic relations between different views on probability cannot be presented. However, by and large Galavotti is quite successful in circumscribing the technical matters. Her non-technical treatment of randomness, for example, is highly informative. It is a missed chance that she does not provide a similar easy access to some of the uses of probability in scientific modelling.

The above comments basically say that the role of probability in the sciences, both methodological and theoretical, is not given due attention in the book. In part, this is saying that I would have liked Galavotti to write a different book, one she simply did not write. Hers is a book about the concept of probability, not about its various applications in the sciences. But even apart from that, I think it is unfair to blame Galavotti for a lack of attention. To some extent the whole field may be held responsible for this. By and large, the inductive logics of Carnap and his co-workers were developed quite independently of the statistical tools that served the sciences. And similarly, after it was established that the subjects described in the cognitive and social sciences fail to comply with philosophically motivated models of probabilistic reasoning, philosophers and scientists happily went their separate ways. In other words, the limited attention for science in the book may eventually be blamed on the philosophy of probability itself. In light of this it is a hopeful sign that some philosophers of probability, such as Glymour, Douven and Fitelson, have turned to cognitive and social scientists to improve their own discipline on the descriptive side.

Even with the above-mentioned restrictions on content, Galavotti still provides us with an appealing and didactively attractive introduction into the philosophy of probability. Its distinctive character is the continuous reference to central historical figures in the development of the concept of probability. This determines the character of the book so much that the title might

have read “Historical Introduction to Probability”. However, such a title would ignore the fact that by following the development of the concept of probability we get an informative introduction into systematic aspects of that concept as well. Apart from the entertaining character of history itself I can therefore, together with the students that have used it as part of my course on interpretations of probability, recommend this book as an enjoyable and informative introduction.