

A PHILOSOPHICAL INTRODUCTION TO PROBABILITY

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In memory of Dick Jeffrey (1926-2002) and Wes Salmon (1925-2001)
unforgettable teachers and friends.

INTRODUCTORY REMARKS

Everybody agrees that life is dominated by uncertainty. Being a tool that enables us to face uncertainty, probability is an essential ingredient of human knowledge, both in everyday life and science. It is therefore natural that probability should be of some concern to philosophy, and it is precisely from a philosophical standpoint that it is addressed in this book. Probability invests all branches of philosophical investigation, from epistemology to moral and political philosophy, and impinges upon major controversies, like that between determinism and indeterminism, or between free will and moral obligation, and problems such as: ‘What degree of certainty can human knowledge attain?’ ‘What is the relationship between probability and certainty?’ ‘What is the meaning of chance and its place in science?’. It is therefore advisable to narrow down the subject of this book and be very specific on what it is about.

This book focuses on the foundations of probability, and more specifically on the central problem in that context, namely that of the interpretation of the notion of probability. This notion will be taken in the quantitative meaning today associated with it, that is as a quantitative notion expressible by means of a function that assigns a hypothesis a value ranging in the interval 0-1. The given hypothesis can be a prediction regarding the occurrence of a singular event, or the expression of a general law concerning the behaviour of a (finite or infinite) class of events.

Ever since it took shape in the mid-seventeenth century, probability has been the object of wide scale debate. However, of its two sides: the mathematical one and the philosophical one, the latter is far more controversial, due to the fact that probability can be taken as referring to our beliefs concerning what is uncertain, as well as to fortuitous events

themselves. But while probability in relation to uncertainty is a characteristic of human knowledge - whose intrinsic incompleteness and imperfection make it necessary to appeal to probability - in relation to fortuitous events probability represents an ingredient of the description of an indeterministic world. This twofold meaning of the term lies at the roots of the various interpretations of probability, which have occasioned an ongoing controversy.

While focusing on the problem of the interpretation of probability, the following pages concentrate on a number of authors who have made specific contributions to the clarification and development of probability, taken in the quantitative sense specified above. The reader should not be surprised to find that many renowned philosophers, such as John Locke and Immanuel Kant, who did not address the notion of probability as we conceive it, are not mentioned in this book. The same holds for the meaning and uses of probability before the modern concept was spelled out. Furthermore, little space is devoted to induction taken in a general, non-probabilistic, sense. An extensive treatment of this notion - which belongs in the history of western thought since its very beginning - would require another volume. Instead, the book focuses on the peculiar traits and epistemological implications of the various interpretations of probability, and an effort is made to highlight the differences between the perspectives embraced by the authors adhering to each of them. The picture that emerges is much more diversified than is usually thought, to witness to the richness of the foundational debate revolving around probability.

Chapter 1 has a historical character and is meant to introduce the reader to the evolution of modern probability from its birth in the seventeenth century onwards. This chapter includes a section on the relationships between probability and induction - two notions that are now seen as intertwined, but were long addressed separately.

Chapter 2 introduces the mathematical properties of the concept of probability in a

simple fashion, that does not presuppose in the reader a mathematical background. The chapter includes an account of Bayes' rule and Kolmogorov's axiomatization, which represent remarkable steps in the evolution of probability.

Chapter 3 is devoted to the so-called 'classical' interpretation of probability, worked out by Pierre Simon de Laplace at the turn of the nineteenth century. Laplace's theory of probability became very influential, and dominated the literature on the topic for a long time. It also raised various problems that provoked a vast debate. Favoured by the progressive widening of the range of application of probability, other interpretations were put forth in the nineteenth century to cope with the difficulties besetting Laplace's theory.

While the notion of probability developed by Laplace focuses on the epistemic meaning of probability, which is regarded as a component of human knowledge, an alternative viewpoint stresses the empirical aspect of probability and defines it in terms of frequencies. This is the frequency interpretation of probability, which took shape during the nineteenth century, and in the twentieth century became most popular with scientists, especially physicists. Chapter 4 deals with this interpretation, concentrating on the work of Robert Leslie Ellis, John Venn, Richard von Mises, Hans Reichenbach and Ernest Nagel.

Frequentism faces a problem in connection with the interpretation of quantum mechanical probabilities. In an attempt to deal with this difficulty, Karl Popper advanced the so-called 'propensity' interpretation in the late fifties. This had been anticipated by Charles Sanders Peirce, but after Popper's work it gained an ample consensus among philosophers of science. Chapter 5 outlines Popper's propensity interpretation and the ensuing debate. This chapter includes a section on chance and randomness, in which Henri Poincaré's account of chance phenomena in terms of their complexity and instability is discussed, and attention is drawn on the relativity of the notion of randomness. Finally, the reader will find some

remarks on the objectivity of chance and its implications for the determinism/indeterminism issue.

Chapter 6 is devoted to the logical interpretation of probability. In contrast with the frequentist outlook, logicians follow Laplace in regarding probability as an epistemic notion. However, in an attempt to proceed beyond Laplace, they borrow the conceptual apparatus of logic. The chapter outlines the conception of probability of a number of authors, including Augustus De Morgan, George Boole, Stanley Jevons, John Maynard Keynes, William Ernest Johnson, Ludwig Wittgenstein, Friedrich Waismann, Rudolf Carnap - whose theory of probability marks the climax of the logical interpretation - and Harold Jeffreys.

Chapter 7 deals with the subjective interpretation of probability, which is currently the most popular version of the epistemic approach to probability. While sharing with logicians the conviction that probability pertains to our knowledge, rather than to stochastic phenomena, subjectivists stray from the former in that they claim that a given body of evidence supports one and only one correct evaluation of probability, relative to a given hypothesis. According to subjectivists, probability evaluations reflect degrees of belief, whose determination depends on a number of factors including a variety of elements, in addition to the available information. Special attention is paid to the work of Frank Ramsey and Bruno de Finetti, the most outstanding representatives of this current in the last century. Some recent trends in Bayesian epistemology, as upheld by such authors as Richard Jeffrey and Patrick Suppes, will be discussed.

Given the introductory character of this book, an effort has been made to keep the presentation as simple as possible, to address a broad readership - possibly from different backgrounds - who share an interest in the foundational problems connected with the concept of probability. As I stressed at the outset, the implications of the subject matter of this book

are so numerous that any claim to completeness must of necessity be abandoned. Consequently, non-beginner readers will find that a number of authors who contributed in some way or other to the debate on the foundations of probability have been barely mentioned or not mentioned at all, and the same holds for various aspects or implications of the problems addressed. And of course much more could have been said about the topics and authors discussed. Nevertheless I hope that, with all its limitations, the following book will be of some use to those concerned with the problems relating to the philosophical side of the notion of probability.

This book originates from my volume in Italian *Probabilità* (Florence: La Nuova Italia Scientifica, 2000), of which it is an expanded and completely revised version. Encouragement to produce this book came from a number of colleagues and friends, whose appreciation for my work has proved an invaluable support. Among them, I wish to mention with all my gratitude Pat Suppes, from whom I learned much more than I could tell, and whose support for the project of this book has been its *conditio sine qua non*. I owe an equally deep debt of gratitude to the memory of Wes Salmon, who first stimulated my interest in probability long ago, when I was a graduate student at Indiana University, and to that of Dick Jeffrey, who a few years later introduced me to subjective probability: ‘the real thing’ as he called it in the title of his last book. Sure enough, with such teachers, this book should be much better than it is.

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A philosophical essay on probabilities. Item Preview. remove-circle. Share or Embed This Item. EMBED.Â texts. A philosophical essay on probabilities. by. Laplace, Pierre Simon, marquis de, 1749-1827. Publication date. 1902. Publisher. New York : J. Wiley ; London : Chapman & Hall. Probability: A Philosophical Introduction introduces and explains the principal concepts and applications of probability. It is intended for philosophers and others who want to understand probability as we all apply it in our working and everyday lives. The book is not a course in mathematical probability, of which it uses only the simplest results, and avoids all needless technicality. The role of probability in modern theories of knowledge, inference, induction, causation, laws of nature, action and decision-making makes an understanding of it especially important to philosophers and student