Preface

This book is about one of the greatest intellectual failures of the twentieth century—several unsuccessful attempts to construct a scientific theory of probability. Probability and statistics are based on very well developed mathematical theories. Amazingly, these solid mathematical foundations are not linked to applications via a scientific theory but via two mutually contradictory and radical philosophies. One of these philosophical theories ("frequency") is an awkward attempt to provide scientific foundations for probability. The other theory ("subjective") is one of the most confused theories in all of science and philosophy. A little scrutiny shows that in practice, the two ideologies are almost entirely ignored, even by their own "supporters."

I will present my own vision of probability in this book, hoping that it is close to the truth in the absolute (philosophical and scientific) sense. This goal is very ambitious and elusive so I will be happy if I achieve a more modest but more practical goal—to construct a theory that represents faithfully the foundations of the sciences of probability and statistics in their current shape. A well known definition of physics asserts that "Physics is what physicists do." I ask the reader to evaluate my theory by checking how it matches the claim that, "Probability is what probabilists and statisticians do." I want to share my ideas on probability with other people not because I feel that I answered all questions, but because my theory satisfies my craving for common sense.

I have already alluded to two intellectual goals of this book, namely, a detailed criticism of the philosophical theories of von Mises ("frequency theory") and de Finetti ("subjective theory"), and a presentation of my own theory. The third goal, at least as important as the first two, is education. The writings of von Mises and de Finetti can be easily found in libraries,

yet their main ideas seem to be almost completely unknown. How many statisticians and other scientists realize that both von Mises and de Finetti claimed that events do not have probabilities? How many educated people would be able to explain in a clear way what the two philosophers tried to say by making this bold claim? Even if the reader rejects my criticism of von Mises' and de Finetti's theories, and also rejects my own theory, I hope that at least he will attain a level of comprehension of the foundations of probability that goes beyond the misleading folk philosophy.

It is hard to be original in philosophy but this book contains a number of ideas that I have not seen anywhere in any form. My "scientific laws of probability" (L1)-(L5), presented in Sec. 1.2, are new, although their novelty lies mainly in their form and in their interpretation. My critique of the subjective philosophy contains novel ideas, including a proof that the subjective theory is static and so it is incompatible with the inherently dynamic statistics (see Sec. 7.6). I show that the frequency statistics has nothing in common with the frequency philosophy of probability, contrary to the popular belief. Similarly, I show that, contrary to the popular belief, the Bayesian statistics has nothing in common with the subjective philosophy of probability. My interpretation of the role of Kolmogorov's axioms is new, and my approach to decision theory contains new proposals.

The book is written from the point of view of a scientist and it is meant to appeal to scientists rather than philosophers. Readers interested in the professional philosophical analysis of probability (especially in a more dispassionate form than mine) may want to start with one of the books listed in Chap. 15.

I am grateful to people who offered their comments on the draft of the manuscript and thus helped me improve the book: Itai Benjamini, Erik Björnemo, Nicolas Bouleau, Arthur Fine, Artur Grabowski, Peter Hoff, Wilfrid Kendall, Dan Osborn, Jeffrey Rosenthal, Jaime San Martin, Pedro Terán, John Walsh, and anonymous referees.

Special thanks go to Janina Burdzy, my mother and a probabilist, for teaching me combinatorial probability more than 30 years ago. The lesson about the fundamental role of symmetry in probability was never forgotten.

I am grateful to Agnieszka Burdzy, my wife, for the steadfast support of my professional career.

I acknowledge with gratitude generous support from the National Science Foundation.

Seattle, 2008