Graduate Texts in Physics

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Probability for Physicists

Springer

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ISSN 1868-4513 ISSN 1868-4521 (electronic)
Graduate Texts in Physics
ISBN 978-3-319-31609-3 ISBN 978-3-319-31611-6 (eBook)
DOI 10.1007/978-3-319-31611-6

Library of Congress Control Number: 2016937517

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG Switzerland

Preface

University-level introductory books on probability and statistics tend to be long—too long for the attention span and immediate horizon of a typical physics student who might wish to absorb the necessary topics in a swift, direct, involving manner, relying on her existing knowledge and physics intuition rather than asking to be taken through the content at a slow and perhaps over-systematic pace.

In contrast, this book attempts to deliver a concise, lively, intuitive introduction to probability and statistics for undergraduate and graduate students of physics and other natural sciences. Conceived primarily as a text for the second-year course on *Probability in Physics* at the Department of Physics, Faculty of Mathematics and Physics, University of Ljubljana, it has been designed to be as relieved of unnecessary mathematical ballast as possible, yet never to be mathematically imprecise. At the same time, it is hoped to be colorful and captivating: to this end, I have strived to avoid endless, dry prototypes with tossing coins, throwing dice and births of girls and boys, and replace them wherever possible by physics-motivated examples, always in the faith that the reader is already familiar with "at least something". The book also tries to fill a few common gaps and resurrect some content that seems to be disappearing irretrievably from the modern, Bologna-style curricula. Typical witnesses of such efforts are the sections on extreme-value distributions, linear regression by using singular-value decomposition, and the maximum-likelihood method.

The book consists of four parts. In the first part (Chaps. 1–6) we discuss the fundamentals of probability and probability distributions. The second part (Chaps. 7–10) is devoted to statistics, that is, the determination of distribution parameters based on samples. Chapters 11–14 of the third part are "applied", as they are the place to reap what has been sown in the first two parts and they invite the reader to a more concrete, computer-based engagement. As such, these chapters lack the concluding exercise sections, but incorporate extended examples in the main text. The fourth part consists of appendices. Optional contents are denoted by asterisks $\star$. Without them, the book is tailored to a compact one-semester course;

with them included, it can perhaps serve as a vantage point for a two-semester agenda.

The story-telling and the style are mine; regarding all other issues and doubts I have gladly obeyed the advice of both benevolent, though merciless reviewers, Dr. Martin Horvat and Dr. Gregor Šega. Martin is a treasure-trove of knowledge on an incredible variety of problems in mathematical physics, and in particular of *answers* to these problems. He does not terminate the discussions with the elusive "The solution exists!", but rather with a fully functional, tested and documented computer code. His ad hoc products saved me many hours of work. Gregor has shaken my conviction that a partly loose, intuitive notation could be reader-friendly. He helped to furnish the text with an appropriate measure of mathematical rigor, so that I could ultimately run with the physics hare and hunt with the mathematics hounds. I am grateful to them for reading the manuscript so attentively. I would also like to thank my student Mr. Peter Ferjančič for leading the problem-solving classes for two years and for suggesting and solving Problem 5.6.3.

I wish to express my gratitude to Professor Claus Ascheron, Senior Editor at Springer, for his effort in preparation and advancement of this book, as well as to Viradasarani Natarajan and his team for its production at Scientific Publishing Services. http://pp.books.fmf.uni-lj.si

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