Maximum-Entropy and Bayesian Methods in Science and Engineering

Volume 1: Foundations

Fundamental Theories of Physics

An International Book Series on The Fundamental Theories of Physics: Their Clarification, Development and Application

Maximum-Entropy and Bayesian Methods in Science and Engineering

Volume 1: Foundations

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In honour of E. T. Jaynes

Of Related Interest

Maximum-Entropy and Bayesian Methods in Inverse Problems

Edited by

C. Ray Smith and W. T. Grandy, Jr.

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The University of Wyoming, Laramie, Wyoming, U.S.A.

This volume is the outcome of two workshops entitled "Maximum-Entropy and Bayesian Methods in Applied Statistics" and presents contributions by renowned authorities in many different fields. The purpose of these workshops was to bring together leading scientists whose research involved using the Principle of Maximum Entropy in a wide range of different applications in order to pool the experience gained and to identify common problems in need of solution. The result is stimulating and informative and provides many directions for further progress.

Audience

"Maximum-Entropy and Bayesian Methods in Inverse Problems" will be of great interest to mathematicians, physicists, geophysicists, electrical engineers, economists, and those working in communication and information theory and many other aspects of signal processing.

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Of Related Interest

Maximum-Entropy and Bayesian Spectral Analysis and Estimation Problems

Edited by

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U.S Army Missile Command, Redstone Arsenal, Alabama, U.S.A.

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Department of Electrical Engineering,
Seattle University, Seattle, Washington, U.S.A.

This volume contains 20 contributions by leading researchers from different fields who critically examine maximum-entropy and Bayesian methods in science, engineering, signal processing, medical physics, and other disciplines.
This is a sequel to the volume "Maximum-Entropy and Bayesian Methods in Inverse Problems', published by Reidel in 1985.

Audience

This book will be of interest to probability theorists, statisticians, electrical engineers, communication engineers, computer scientists, physicists, mathematicians, biologists, geophysicists, and those working in medical imaging.

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Volume 2: Applications

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PREFACE

This volume has its origin in the Fifth, Sixth and Seventh Workshops on "Maximum-Entropy and Bayesian Methods in Applied Statistics", held at the University of Wyoming, August 5-8, 1985, and at Seattle University, August 5-8, 1986, and August 4-7, 1987. It was anticipated that the proceedings of these workshops would be combined, so most of the papers were not collected until after the seventh workshop. Because all of the papers in this volume are on foundations, it is believed that the contents of this volume will be of lasting interest to the Bayesian community.

The workshop was organized to bring together researchers from different fields to critically examine maximum-entropy and Bayesian methods in science and engineering as well as other disciplines. Some of the papers were chosen specifically to kindle interest in new areas that may offer new tools or insight to the reader or to stimulate work on pressing problems that appear to be ideally suited to the maximum-entropy or Bayesian method. A few papers presented at the workshops are not included in these proceedings, but a number of additional papers not presented at the workshop are included. In particular, we are delighted to make available Professor E. T. Jaynes' unpublished Stanford University Microwave Laboratory Report No. 421 "How Does the Brain Do Plausible Reasoning?" (dated August 1957). This is a beautiful, detailed tutorial on the Cox-Polya-Jaynes approach to Bayesian probability theory and the maximum-entropy principle. In addition to the paper just described, we have included three more by Professor Jaynes: "The Relation of Bayesian and Maximum-Entropy Methods" (presented at the fifth workshop). "The Evolution of Carnot's Theory" (based upon a talk given at an EMBO Workshop in 1984) and "Detection of Extra-Solar System Planets" (made available for this volume). This last paper should pique the interest of anyone concerned with "superresolution". Incidentally, Professor Jaynes refers in this paper to the Ph.D. thesis of G. L. Bretthorst; much of Dr. Bretthorst's thesis appears as Chapter 5 of this volume.

These workshops and their proceedings could not have been brought to their final form without the support or help of a number of people. Professor Alwyn van der Merwe, the Editor of Fundamental Theories of Physics, and Dr. D. J. Larner of Kluwer, provided encouragement and friendship at critical times. Others who have made our work easier or more rewarding include Professor Paul D. Neudorfer of Seattle University, Mr. Robert M. Braukus, P.E., Director of Telecommunications of Puget Sound Power and Light Co., Dr. J. M. Loomis of the Radar Technology Branch of MICOM's Research, Development, and Engineering Center, and Dr. Rabinder Madan of the Office of Naval Research.

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DEDICATION

In commemoration of the thirtieth anniversary of his first papers (published in the Physical Review) on maximum-entropy, the 1987 workshop and these proceedings are proudly dedicated to Edwin T. Jaynes. May his contributions continue for at least another thirty years.