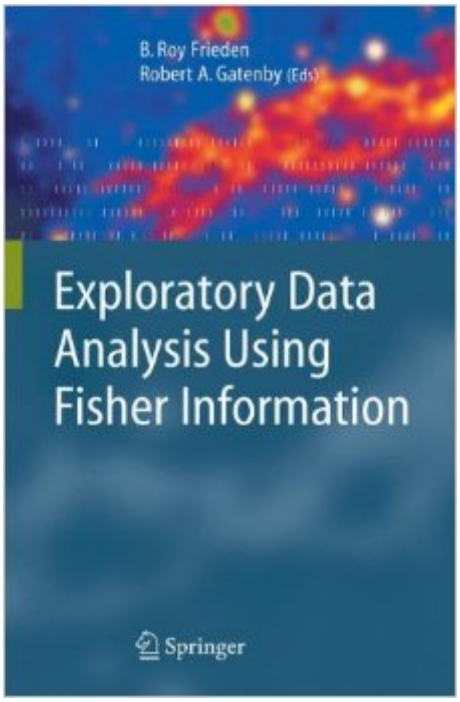
Exploratory Data Analysis Using Fisher Information



Synopsis

This book uses a mathematical approach to deriving the laws of science and technology, based upon the concept of Fisher information. The approach that follows from these ideas is called the principle of Extreme Physical Information (EPI). The authors show how to use EPI to determine the theoretical input/output laws of unknown systems. Will benefit readers whose math skill is at the level of an undergraduate science or engineering degree.

Book Information

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Customer Reviews

B.R. Frieden and R.A. Gatenby (Eds), Exploratory Data Analysis using Fisher Information (Springer, London 2007) For some years now, Roy Frieden has been exploring the consequences of studying physical phenomena on the basis of Fisher information and extreme physical information (EPI). From the very beginning, the results were spectacular. From the slenderest beginnings, many of the fundamental equations of physics emerged from these EPI principles: the Klein-Gordon and Dirac equations of quantum mechanics as well as the SchrÃ¶dinger equation; Newton's second law; Maxwell's equations; many of the equations of general relativity; and this does not exhaust the list. These ideas, gradually developed in a series of publications in very respectable and severely refereed scientific journals, were brought together in Physics from Fisher Information (1998) and its successor, Science from Fisher Information (2004). It was clear from that work that the approach should not be limited to physics but the extent to which it has shown itself fruitful, charted in Frieden's latest book, is a revelation. This is not a monograph but a collection of essays, edited by

Frieden and R.A. Gatenby, a life scientist, on a very wide range of topics, all of which are shown to benefit from the use of EPI. The book begins with an introduction by Frieden, in which the reader is told what Fisher information is and how to use it, employing the EPI approach. Eight chapters follow, contributed by the editors and 11 other authors, on financial economics (Frieden, R.J. Hawkins and and J.L. d'Anna); tissue growth and cancer (by the editors); statistical mechanics and `thermal physics' - not very different from what I was taught to call thermodynamics (A. and A.R. Plastino); astrobiology (by Frieden and B.H.

In a simple-minded way Fisher information can be expressed in one dimensionas an integral of (P') squared over P where P is a suitable probability density.For example P could be the square modulus of a quantum wave function.Many action principles for physical systems in quantum mechanics orrelativity involve extremizing a Lagrangian which contains such Fisher information(FI) terms. The book applies such ideas to a huge variety of physical, biological,economic, ecological, social, game theoretical, and informational systems.One uses FI in a unified approach to statistically based science calledEPI (extreme physical information). This leads to a program (EPA) ofexploratory data analysis whose inputs are real or Gedanken data and whoseoutputs are the natural laws governing a system. The results often appear in the form ofdifferential equations. Here one thinks of theuniverse as information-dominated and "participatory", of Harrison type,allowing maximuminformation gain at each observation and "favoring" the intelligentobservation of information.One speaks of three levels of solution for EPI,depending on the three levels of prior knowledge categorized by the19th century philosopher C. Pierce. These are(A) The highest levelor "abduction", giving exact (quantum) solutions; (B) The next highest levelor "deduction", giving accurate but inexact (non-quantum) solutions ofclassical physics; and(C) The lowest level or "induction" using merely empirical data giving approximatebut smooth solutions.

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