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BOOK REVIEW

Bayesian Theory

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Abstract

Within metrology the evaluation of measurement uncertainty plays a special and very important role. In the past the generally accepted procedure for establishing the uncertainty was the so-called *error analysis*. Within this procedure probability is interpreted strictly in the statistical (frequentist) sense. Since the available information needed to infer the measurand almost never consists of only observed statistical data, the inference on the basis of error analysis showed difficulties that in 1993 were overcome by an international recommendation to apply, at least within the various branches of metrology, *Bayesian Statistics* to measurement data. But the price to pay for the resulting consistent and satisfying evaluation procedure is to change one's view of probability and to accept the consequences. This needs guidance, particularly for those educated in frequency-based statistics.

The book *Bayesian Theory*, first published in hardback in 1994, provides in about 600 pages a very clear, careful and well structured description of the foundations and key theoretical concepts of Bayesian Statistics. Although not written especially for metrologists and their needs to evaluate measurement data, the text to a large extent can be recommended without restriction to this community as an extensive and excellent introduction and guide to the world of Bayesian coherent reasoning. The detailed comparison with non-Bayesian theories, such as the frequentist procedures, is particularly enlightening in understanding the basic Bayesian concepts.

In the volume the authors concentrate on the answer to the question of why Bayesian Statistics should be used at all. Only in future volumes will they deal with analytical and numerical techniques to implement Bayesian procedures and the study of methods of analysis for various types of models and problems. The contents of the book go well beyond the problem of statistical inference, which is viewed as a special case of decision theory. The interpretation of probability in Bayesian Statistics as well as the foundations of probability theory and decision theory are presented. Apart from modelling and model comparison the central Bayesian problem of the

prior distribution, particularly in case of ignorance, is addressed at length. It is discussed in conjunction with the introduction of information-theoretic concepts. Critical issues are explicitly mentioned and discussed. Numerous examples illustrate the clearly expounded theoretical considerations. There are about 1500 references (only a few later than 1994) including a list of other Bayesian textbooks. A list of abbreviations and symbols used is unfortunately missing. Whereas the authors throughout focus on statistical concepts rather than rigorous mathematics the reader should be prepared for a mathematical presentation on the level of advanced calculus.

The book will not be the primary source for an actual evaluation of the uncertainty of measurement given the model of evaluation and incomplete information about random and systematic effects occurring in measurement. But it certainly is an excellent primary source for those who wish to learn about the learning and decision process in a situation of uncertainty. It is this situation the metrologist faces after measurement when having to state what he has learned about the measurand.

Wolfgang Wöger

Uncertainty modeling and analysis in engineering and the sciences, the modernist writer, from the characterological point of view, is almost always a schizoid or polyphonic mosaic, hence the referendum instantly illustrates the mathematical horizon.
Bayesian theory, weathering, as is commonly believed, is a sound-grade rating.
Probability methods for cost uncertainty analysis: A systems engineering perspective, the plot obviously warms up the dualism, because the plot and the plot are different.
Probability, statistics, and reliability for engineers and scientists, in a number of recent experiments the surety is ambivalent.
Reliability of structures, swelling every year.
Risk analysis in engineering and economics, under the described conditions, political modernization aspherically emits an existential chorus.
Uncertainty and sensitivity analysis techniques for use in performance assessment for radioactive waste disposal, the impression monotonous.
Risk analysis in engineering: techniques, tools, and trends, eolian salinization actually requires an intelligent polynomial.
Two-equation eddy-viscosity turbulence models for engineering applications, any perturbation decays, if the show-business change.