*Journal of Statistical Physics, Vol. 48, Nos. 3/4, 1987*

# Book Review: *Maximum Entropy and Bayesian Methods in Applied Statistics*

**Maximum Entropy and Bayesian Methods in Applied Statistics.** James H. Justice, ed., Cambridge University Press, Cambridge, 1986, 279 pp.

Ordinarily, books on applied statistics would not rate a review in the *Journal of Statistical Physics*, but since this is a case of a local boy making good, an exception will be made. Applications of the maximum entropy formalism in a statistical context have been popping up in many different scientific disciplines. To reduce this methodology to a few words, the maximum entropy method furnishes the smoothest possible curve (or surface) consistent with a given set of data. In most elementary applications not involving large data sets it is no harder to use than one remembers from a first course in statistical mechanics. One writes down an equation for the entropy and maximizes it subject to constraints imposed by the data. In this form it has been applied, with mixed success, to the analysis of time series, traffic theory, geophysical exploration problems, NMR, crystallography, image reconstruction, and undoubtedly other areas that I have not heard about yet. Bayesian statistics basically assume that data at hand can be described by an underlying postulated (or calculated) distribution. Experiments are used to update estimates of the parameters that characterize the distribution. The maximum entropy technique is used to furnish information on the prior distribution to be used in the analysis.

This book is the proceedings of a meeting held on the subject in 1984, and contains papers by several proponents of the technique. There are two large introductory papers on the subject by E. T. Jaynes that are unfortunately so enthusiastic and so wordy that it is impossible to identify a central point to his arguments. On the other hand, there are a number of well-written introductory articles by R. D. Levine on maximum entropy estimates used by him and his collaborators in physical chemistry, by S. F. Gull and J. Fielden on estimation in Bayesian nonparametric statistics, by J. Skilling on maximum entropy methods in image reconstruction, by C. G. Gray on spectroscopic applications of maximum entropy



0022-4715/87/0800-0951$05.00/0 

estimates, by E. Rietsch on reconstruction of the earth's interior, and by J. H. Justice on maximum entropy in exploration seismology, as well as a number of more technical articles.

It is not yet clear whether the use of maximum entropy methods is clearly advantageous in all of the fields in which its use has been proposed. It is also still something of a mystery as to why so few data need to be known to determine the shape of a distribution. In the estimation of origin–destination models for traffic surveys in the early 1970s the benefits of the use of the maximum entropy formalism were not that readily apparent. On the other hand, it seems to be extremely promising in the field of crystallography, and in the hands of R. D. Levine and his collaborators it has produced many useful results in the analysis of various experiments in physical chemistry.

While the utility of methods based on maximum entropy is not yet clearly delineated, they clearly hold some promise. This volume is an excellent starting point for getting the flavor of the subject.

George H. Weiss
*National Institutes of Health*
*Bethesda, Maryland 20892*

*Journal of Statistical Physics, Vol. 48, Nos. 3/4, 1987*

# Book Review: *Statistical Mechanics of Periodic Frustrated Ising Systems*

**Statistical Mechanics of Periodic Frustrated Ising Systems.** R. Liebmann, Springer-Verlag, New York, 1986.

The term frustration, coined by Toulouse some 10 years ago, refers to situations in spin systems whose competing interactions cannot be simultaneously minimized. While the concept of frustration was originally developed in the context of investigations of spin glasses, a wealth of results has been accumulated for systems with periodic frustrations. This book is a review on these latter results for spin-$\frac{1}{2}$ Ising systems, including one further section on the random chain problem.

Periodic frustrated systems are analyzed very much in the same way as homogeneous systems. The intended subject matter therefore spans essentially the entire field of the Ising model, and the compact size of this book (142 pages) necessarily makes the presentation mostly a collection of results with little details given. Materials are grouped according to the dimensionality and type of the lattice of the system, an arrangement that makes the book very useful as a reference. Among the few cases with detailed discussions, treatment of the axial-next-nearest-neighbor Ising chain is very nicely done. But estimations of the ground-state degeneracy for the triangular lattice are redundant, since the exact result is also given. The list of (176) references is relatively small and, therefore, hardly complete. Notable omissions include mean-field discussions, other approaches to layered models (by Hahn and co-workers, and by McCoy and co-workers, e.g.), connections with stochastic crystal growth models (by Enting, e.g.) and the Baxter model (by Jüngling, e.g.), and the exact disorder solution of a frustrated simple cubic lattice (by Jaekel and Maillard).

Despite these drawbacks and occasional minor slips (*absorption* mistaken for *adsorption*, Ref. 166 duplicates 52, e.g.), this book represents a timely and worthwhile effort in describing the field and, as such, serves as a useful resource for researchers and students.

F. Y. Wu
*Department of Physics*
*Northeastern University*
*Boston, Massachusetts 02115*



0022-4715/87/0800-0953$05.00/0 