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TWO BOOKS ON LARGE DEVIATIONS

RICHARD S. ELLIS, *Entropy, Large Deviations, and Statistical Mechanics*, Springer, New York, 1985, 368 pages, $54.00.

D. W. STROOCK, *An Introduction to the Theory of Large Deviations*, Springer, New York, 1984, 196 pages, $20.40.

REVIEW BY PETER NEY

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Large deviation theory is a part of probability limit theory which forms a natural complement to the laws of large numbers. Where the latter describes the convergence of a sequence of random elements to a mean or equilibrium state, the former focuses on the probabilities that the random quantities are in sets away from the central tendency. Under suitable moment hypotheses these probabilities decay exponentially fast. Interest centers on the exponents or rate functions, which are usually given by variational formulas involving an entropy function. A variety of mathematical techniques come into play, including convexity theory and Legendre transforms, asymptotic Laplace-type arguments, and various transformations or "twisting" of measures. Another source of stimulus to the theory has come from its interaction with other areas such as statistical inference, information theory, statistical physics, and stochastic dynamical systems.

Though there has been a steady history of contributions to the theory since the original paper of H. Cramér in 1938, large deviations has become an especially active research area during the last decade. Much of the impetus for this activity has come from the seminal work of M. Donsker and S. R. S. Varadhan [3] and their students in the United States, and from M. I. Freidlin and A. D. Wentzell in the Soviet Union (see, e.g., [4]).

Recently several monographs and books on the subject have been published. Two of these are the subject of this review.

As the title indicates, Richard Ellis' book is directed to the interface of large deviation theory with statistical mechanics. The relevance of large deviation ideas in statistical mechanics was extensively developed by O. Lanford in his 1971 Batelle Memorial Institute lectures [5]. In his book, Professor Ellis aims to bridge the gap between the physics and the contemporary mathematical developments. The book was this reader's first systematic exposure to the statistical mechanics models, and I feel that it accomplished its goal.

The book can be divided into three parts. The first (Chapters I and II) introduces the basic ideas of LD theory. Rate functions are explicitly calculated for a number of examples by combinatorial methods, which is useful for the beginner. The theory is then carefully developed at three levels. These would

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