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Asymptotic theory of statistical inference, by B. L. S. Prakasa Rao. John Wiley and Sons, New York, Chichester, Brisbane, Toronto, Singapore, 1987, xiv + 438 pp., $49.95. ISBN 0-471-84335-0

Statistics, generally speaking, addresses the problem of how to determine from data knowledge of the underlying mechanism, presumed random, which produces that data. Usually the mechanism is idealized as a probability law which is assumed to belong to a collection of possible laws. If we have abundant data, we expect that we can determine fairly accurately the unknown law, or some aspect of it, say the mean, μ, in which we are interested. The asymptotic theory of statistical inference is the study of how well we may succeed in this pursuit, in quantitative terms. Any function of the data, when the amount of data is n, is called a "statistic" or estimator $\hat{\mu}(n)$ of, e.g., the mean μ. The sequence $\{\hat{\mu}(n)\}$ is said to be consistent for μ if $\hat{\mu}(n)$ converges to μ as n goes to infinity. The sequence is said to be asymptotically normal (regrettably, language is abused this way) if $\hat{\mu}(n) - \mu$ can be normalized so that the law of the resulting sequence converges to a normal distribution. Proofs that particular estimators have these and other nice properties in various versions and settings comprise much of the work of classical and modern asymptotic statistics.

In purely mathematical terms, the subject is about convergence of sequences of functions or measures in various senses; in particular its tools are drawn from that part of real analysis and measure theory called probability theory.

Until rather recently, some would say "classically", a large portion of probability theory dealt with operations on sequences of independent random variables, and statistical models assumed that data consisted of sequences of independent observations. As probability theory began to focus on other processes—Markov processes in the 50s and 60s, and stationary time series in the 60s and 70s, mathematical statistics began to deal with models where observations were assumed to follow these patterns.

The last ten or fifteen years have produced a strong thrust of activity in several areas associated with stochastic processes: stochastic integrals, stochastic analysis, stochastic differential equations, weak and strong convergence of stochastic processes, etc. A class of processes receiving a lot of attention is the very broad class called semimartingales. During the same time period there has been a burst of activity, partly in response to computing power and convenience, in techniques of data analysis, statistical software packages, and adaptive statistical procedures. The subject of asymptotic statistics, buoyed up, perhaps, by the prosperity of its neighbors, has taken off energetically in a number of fresh directions.

In such a situation it is a daring step to write a book whose stated aim is to bring up to date the interface between probability theory and asymptotic