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Abstract

This book presents an introduction to methods of Nonparametric Statistics. The necessary mathematical tools of multivariate and asymptotic statistics are developed, such as random vectors and sequences of random vectors, and asymptotic properties of estimators and methods of deriving asymptotic distributions are developed. The aforementioned topics are extended also for stochastic processes and sequences of stochastic processes, giving the necessary background for strong and weak convergence in that framework. In this way, a deeper understanding of the empirical distribution function and of the empirical processes is achieved, which are in the core of the development of Nonparametric Statistics and the Kolmogorov-Smirnov and Cramér-von Mises tests. The theorem of Glivenko-Cantelli is presented in great detail and convergence rates and methods of constructing confidence bands with the help of the empirical distribution function are also given.

Through the presentation of important stochastic processes, such as the Gaussian ones and the Brown bridge, the convergence of the empirical process to the Brown bridge is presented. Despite the focus on the asymptotic theory, the topic of the exact distribution of the Kolmogorov-Smirnov statistic is also described. Two chapters of the book describe some classic nonparametric tests, such as the chi-square test and some of its variants, as well as the Kolmogorov-Smirnov, the Cramér-von Mises, the Mann-Whitney, the Wilcoxon, the Shapiro-Wilk and others. The last two chapters of the books deal with the topics of nonparametric density estimation and the Bootstrap method, including also the Jackknife one. A notable characteristic of this book is the combination of a rigorous mathematical framework with a systematic use of the R software (with free accessible code) for a better understanding of the theory with simulated, but also with real data.

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