

Article

Asymptotic Expansions for Symmetric Statistics with Degenerate Kernels

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Abstract: Asymptotic expansions for U-statistics and V-statistics with degenerate kernels are investigated, respectively, and the remainder term $O(n^{1-p/2})$, for some $p \geq 4$, is shown in both cases. From the results, it is obtained that asymptotic expansions for the Cramér–von Mises statistics of the uniform distribution $U(0, 1)$ hold with the remainder term $O(n^{1-p/2})$ for any $p \geq 4$. The scheme of the proof is based on three steps. The first one is the almost sure convergence in a Fourier series expansion of the kernel function $u(x, y)$. The key condition for the convergence is the nuclearity of a linear operator T_u defined by the kernel function. The second one is a representation of U-statistics or V-statistics by single sums of Hilbert space valued random variables. The third one is to apply asymptotic expansions for single sums of Hilbert space valued random variables.

Keywords: U-statistics; V-statistics; asymptotic expansion; integral kernel; nuclearity

MSC: 60B12; 60F05; 62G20



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1. Introduction

Asymptotic expansions for symmetric statistics are studied by many people. See, e.g., Callaert–Janssen–Veraverbeke (1980) [1], Withers (1988) [2], Masono (2004) [3], and so on. They treat U-statistics with non-degenerate kernels. On the other hand, Bentkus–Götze (1999) [4] and Zubayraev (2011) [5] obtained optimal bounds in asymptotic expansions for U-statistics with degenerate kernels. They treat the following modified U-statistics,

$$W_n = \frac{1}{n^2} \sum_{1 \leq i < j \leq n} \phi(\xi_i, \xi_j) + \frac{1}{n} \sum_{1 \leq i \leq n} \phi_1(\xi_i), \quad (1)$$

where $\phi(\cdot, \cdot)$ is a symmetric function, $\phi_1(\cdot)$ is a measurable function and $\{\xi_i\}$ are i.i.d. random variables. W_n coincides with V-statistics when

$$\phi_1(x) = \frac{1}{2} \phi(x, x). \quad (2)$$

If $\phi_1(x) = 0$ for any x , then W_n coincides with U-statistics. They obtained asymptotic expansions with remainder $O(n^{-1})$ for the distribution function of W_n . In this paper, we investigate asymptotic expansions for the simple U-statistics and the V-statistics with degree two defined by

$$U_n = \frac{2}{n^2} \sum_{1 \leq i < j \leq n} u(\xi_i, \xi_j), \quad V_n = \frac{1}{n^2} \sum_{1 \leq i, j \leq n} u(\xi_i, \xi_j), \quad (3)$$

respectively. We obtain asymptotic expansions with remainder $O(n^{1-p/2})$ for some $p \geq 4$ for the distribution function of U_n or V_n under some assumptions for $\{\xi_i\}$ and $u(x, y)$. Our scheme of the proof is based on three steps. The first one is the almost sure convergence

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State of the Art in Probability and Statistics Mathisca de Gunst, Chris Klaassen, A. W. van der Vaart, 2001

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Asymptotic Expansion of a Partition Function Related to the Sinh-model Gaëtan Borot, Alice Guionnet, Karol K. Kozłowski, 2016-12-08 This book elaborates on the asymptotic behaviour when N is large of certain N dimensional integrals which typically occur in random matrices or in 1 dimensional quantum integrable models solvable by the quantum separation of variables The introduction presents the underpinning motivations for this problem a historical overview and a summary of the strategy which is applicable in greater generality The core aims at proving an expansion up to $o(1)$ for the logarithm of the partition function of the sinh model This is achieved by a combination of potential theory and large deviation theory so as to grasp the leading asymptotics described by an equilibrium measure the Riemann Hilbert approach to truncated Wiener Hopf in order to analyse the equilibrium measure the Schwinger Dyson equations and the bootstrap method to finally obtain an expansion of correlation functions and the one of the partition function This book is addressed to researchers working in random matrices statistical physics or integrable systems or interested in recent developments of asymptotic analysis in those fields

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Asymptotic Statistics Reinhard Höpfner, 2014-01-31 This textbook is devoted to the general asymptotic theory of statistical experiments Local asymptotics for statistical models in the sense of local asymptotic mixed normality or local asymptotic quadraticity make up the core of the book Numerous examples deal with classical independent and identically distributed models and with stochastic processes The book can be read in different ways according to possibly different mathematical preferences of the reader One reader may focus on the statistical theory and thus on the chapters about Gaussian shift models mixed normal and quadratic models and on local asymptotics where the limit model is a Gaussian shift or a mixed normal or a quadratic experiment LAN LAMN LAQ Another reader may prefer an introduction to stochastic process models where given statistical results apply and thus concentrate on subsections or chapters on likelihood ratio processes and some diffusion type models where LAN LAMN or LAQ occurs Finally readers might put together both aspects The book is suitable for graduate students starting to work in statistics of stochastic processes as well as for researchers interested in a precise introduction to this area **Small Sample Asymptotics** Christopher A. Field, Elvezio Ronchetti, 1990

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Vaart, 2000-06-19 This book is an introduction to the field of asymptotic statistics The treatment is both practical and mathematically rigorous In addition to most of the standard topics of an asymptotics course including likelihood inference M estimation the theory of asymptotic efficiency U statistics and rank procedures the book also presents recent research topics such as semiparametric models the bootstrap and empirical processes and their applications The topics are organized from the central idea of approximation by limit experiments which gives the book one of its unifying themes This entails mainly the local approximation of the classical i i d set up with smooth parameters by location experiments involving a single normally distributed observation Thus even the standard subjects of asymptotic statistics are presented in a novel way Suitable as a graduate or Master s level statistics text this book will also give researchers an overview of research in asymptotic statistics

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