SELF-NORMALIZED LARGE DEVIATIONS

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Let $\{X, X_n, n \geq 1\}$ be a sequence of independent and identically distributed random variables. The classical Cramér–Chernoff large deviation states that $\lim_{n \to \infty} n^{-1} \ln P((\sum_{i=1}^{n} X_i)/n \geq x) = \ln \rho(x)$ if and only if the moment generating function of X is finite in a right neighborhood of zero. This paper uses $n^{(p-1)/p} V_{n,p} = n^{(p-1)/p} (\sum_{i=1}^{n} |X_i|^p)^{1/p}$ $(p > 1)$ as the normalizing constant to establish a self-normalized large deviation without any moment conditions. A self-normalized moderate deviation, that is, the asymptotic probability of $P(S_n/V_{n,p} \geq x_n)$ for $x_n = o(n^{(p-1)/p})$, is also found for any X in the domain of attraction of a normal or stable law. As a consequence, a precise constant in the self-normalized law of the iterated logarithm of Griffin and Kuelbs is obtained. Applications to the limit distribution of self-normalized sums, the asymptotic probability of the t-statistic as well as to the Erdős–Rényi–Shepp law of large numbers are also discussed.

1. **Introduction.** Throughout this paper, let (Ω, Σ, P) denote a probability space, and let $\{X, X_n, n \geq 1\}$ be a sequence of independent and identically distributed (i.i.d.) nondegenerate real-valued random variables on the probability space. Put

$$S_n = \sum_{i=1}^{n} X_i, \qquad V_n^2 = \sum_{i=1}^{n} X_i^2, \qquad n = 1, 2, \ldots.$$

The classical Cramér–Chernoff large deviation [Chernoff (1952)] states that if

(A) $$Ee^{t_0 X} < \infty \text{ for some } t_0 > 0.$$

then for every $x > EX$,

$$\lim_{n \to \infty} n^{-1} \ln P\left(\frac{S_n}{n} \geq x\right) = \ln \rho(x),$$

or equivalently,

(1.1) $$\lim_{n \to \infty} P\left(\frac{S_n}{n} \geq x\right)^{1/n} = \rho(x).$$

where $\rho(x) = \inf_{t \geq 0} e^{-tx} Ee^{tX}$.

Roughly speaking, this type of large deviation shows that the convergence rate in the law of large numbers is exponential if the moment generating

Chapter 3 Self Normalized Large Deviations

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Chapter 3 Self Normalized Large Deviations:

Self-Normalized Processes Victor H. Peña,Tze Leung Lai,Qi-Man Shao,2008-12-25 Self normalized processes are of common occurrence in probabilistic and statistical studies A prototypical example is Student s t statistic introduced in 1908 by Gosset whose portrait is on the front cover Due to the highly non linear nature of these processes the theory experienced a long period of slow development In recent years there have been a number of important advances in the theory and applications of self normalized processes Some of these developments are closely linked to the study of central limit theorems which imply that self normalized processes are approximate pivots for statistical inference The present volume covers recent developments in the area including self normalized large and moderate deviations and laws of the iterated logarithms for self normalized martingales This is the first book that systematically treats the theory and applications of self normalization *Asymptotic Theory in Probability and Statistics with Applications* T. L. Lai,Lianfen Qian,Qi-Man Shao,2008 Presents a collection of 18 papers many of which are surveys on asymptotic theory in probability and statistics with applications to a variety of problems This volume comprises three parts limit theorems statistics and applications and mathematical finance and insurance It is suitable for graduate students in probability and statistics **Probability Theory and Mathematical Statistics** B. Grigelionis,J. Kubilius,V. Paulauskas,H. Pragarauskas,R. Rudzkis,V. Statulevičius,2020-05-05 No detailed description available for Probability Theory and Mathematical Statistics

Asymptotic Theory of Statistics and Probability Anirban DasGupta,2008-02-06 This book developed out of my year long course on asymptotic theory at Purdue University To some extent the topics coincide with what I cover in that course There are already a number of well known books on asy totics This book is quite different It covers more topics in one source than areavailableinanyothersinglebookonasymptotictheory Numeroustopics covered in this book are available in the literature in a scattered manner and they are brought together under one umbrella in this book Asymptotic theory is a central unifying theme in probability and statistics My main goal in writing this book is to give its readers a feel for the incredible scope and reach of asymptotics I have tried to write this book in a way that is accessible and to make the reader appreciate the beauty of theory and the insights that only theory can provide Essentially every theorem in the book comes with at least one reference preceding or following the statement of the theorem In addition I have p vided a separate theorem by theorem reference as an entry on its own in the front of the book to make it extremely convenient for the reader to nd a proof that was not provided in the text Also particularly worth mentioning is a collection of nearly 300 practically useful inequalities that I have c lected together from numerous sources This is appended at the very end of the book

Mathematical Reviews ,2005 The Annals of Statistics ,2007 **Probability, Finance And Insurance, Proceedings Of A Workshop** Siu Pang Yung,Tze Leung Lai,Hailiang Yang,2004-06-28 This workshop was the first of its kind in bringing together researchers in probability theory stochastic processes insurance and finance from mainland China Taiwan Hong

Kong Singapore Australia and the United States In particular as China has joined the WTO there is a growing demand for expertise in actuarial sciences and quantitative finance The strong probability research and graduate education programs in many of China s universities can be enriched by their outreach in fields that are of growing importance to the country s expanding economy and the workshop and its proceedings can be regarded as the first step in this direction This book presents the most recent developments in probability finance and actuarial sciences especially in Chinese probability research It focuses on the integration of probability theory with applications in finance and insurance It also brings together academic researchers and those in industry and government With contributions by leading authorities on probability theory particularly limit theory and large derivations valuation of credit derivatives portfolio selection dynamic protection and ruin theory it is an essential source of ideas and information for graduate students and researchers in probability theory mathematical finance and actuarial sciences and thus every university should acquire a copy The proceedings have been selected for coverage in Index to Scientific Technical Proceedings ISTP CDROM version ISI Proceedings Index to Social Sciences Humanities Proceedings ISSHP ISI Proceedings Index to Social Sciences Humanities Proceedings ISSHP CDROM version ISI Proceedings CC Proceedings Engineering Physical Sciences   **Probability, Finance and Insurance** T. L. Lai,Hailiang Yang,Siu Pang Yung,2004 This workshop was the first of its kind in bringing together researchers in probability theory stochastic processes insurance and finance from mainland China Taiwan Hong Kong Singapore Australia and the United States In particular as China has joined the WTO there is a growing demand for expertise in actuarial sciences and quantitative finance The strong probability research and graduate education programs in many of China s universities can be enriched by their outreach in fields that are of growing importance to the country s expanding economy and the workshop and its proceedings can be regarded as the first step in this direction This book presents the most recent developments in probability finance and actuarial sciences especially in Chinese probability research It focuses on the integration of probability theory with applications in finance and insurance It also brings together academic researchers and those in industry and government With contributions by leading authorities on probability theory OCo particularly limit theory and large derivations valuation of credit derivatives portfolio selection dynamic protection and ruin theory OCo it is an essential source of ideas and information for graduate students and researchers in probability theory mathematical finance and actuarial sciences and thus every university should acquire a copy The proceedings have been selected for coverage in OCo Index to Scientific On Large Deviations for Moving Average Processes L Wu Recent Progress on Self Normalized Limit Theorems Q M Shao Limit Theorems for Independent Self Normalized Sums B Y Jing Phase Changes in Random Recursive Structures and Algorithms H K Hwang JohnsonOCoMehl Tessellations Asymptotics and Inferences S N Chiu Rapid Simulation of Correlated Defaults and the Valuation of Basket Default Swaps Z Zhang et al Dynamic Protection with Optimal Withdrawal H U Gerber Ruin Probability for a Model Under Markovian Switching Regime H Yang and other papers Readership

Researchers and graduate students in probability and statistics <u>Journal of the American Statistical Association</u> ,2002

The Fractal Approach to Heterogeneous Chemistry D. Avnir,1989-06-16 Discusses applications of fractal geometry to chemical systems involving complex and highly irregular structures These new mathematical techniques have particular applications in chromatographic adsorbents colloidal systems irregular surfaces branched polymers and many other areas of polymer colloidal and surface chemistry **Optics Letters** ,1996 **Index of Mathematical Papers** ,1973 **Current Index to Statistics, Applications, Methods and Theory** ,1999 The Current Index to Statistics CIS is a bibliographic index of publications in statistics probability and related fields <u>Progress in Low Temperature Physics</u> Cornelis Jacobus Gorter,1955 Vol 6 includes contents of v 1 5 **Cumulative Index to IMS Scientific Journals, 1960-1989** Bruce E. Trumbo,Richard K. Burdick,1990 **SeaWiFS Technical Report Series** ,1997 <u>Успехи Математических Наук</u> ,1960 **Summaries of Papers Presented at the Conference on Lasers and Electro-optics** ,1994 **Energy Research Abstracts** ,1985 **Theory of Probability and Mathematical Statistics** ,1996

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