

ROUGH LIMIT THEOREMS ON LARGE DEVIATIONS
FOR MARKOV STOCHASTIC PROCESSES, II

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(Translated by W. M. Vasilaky)

[This is a continuation of the paper published in Theory of Probability and its Applications, Vol. 21, No. 2, pp. 227-242.]

5. Properties of the Standardized Action Functional

Before deducing from the estimates in Theorems 3.1, 4.1 rough limit theorems on large deviations for families of Markov processes, we shall study the properties of the functional defined for absolutely continuous functions by the formula

$$S_{0T}(\varphi) = \int_0^T H_0(t, \varphi(t); \dot{\varphi}(t)) dt$$

(for other functions, S_{0T} is equal to $+\infty$), where $H_0(t, x; u)$ is a function which is semicontinuous from below in the third argument. In the following section, functionals of this form will act as the standardized action functionals giving the asymptotic behavior of action functionals for families of processes depending on a parameter (the asymptotic behavior under a change of parameter such that the process makes more and more frequent jumps). We set $\Phi_x(s) = \{\varphi : \varphi(0) = x, S_{0T}(\varphi) \leq s\}$.

Let us introduce notation in the manner of § 2: $G_0(t, x; z) \leftrightarrow H_0(t, x; u)$, $\bar{G}_0(z) \leftrightarrow H_0(u)$, $G_0(t, x; z) \leq \bar{G}_0(z)$, $H_0(u) \leq H_0(t, x; u)$, $0 \leq \bar{G}_0(z)$, $0 \leq H_0(u)$.

We introduce the following restrictions on the functions $G_0 \leftrightarrow H_0$:

C. $\bar{G}_0(z) < \infty$ for all z , i.e., $\lim_{|u| \rightarrow \infty} H_0(u)/|u| = \infty$; $H_0(t, x; u) < \infty$ for those u for which $H_0(u)$ is finite;

$$\Delta H_0(h, \delta') = \sup_{\substack{|t-t'| < h \\ |y-y'| < \delta' \\ H_0(t, y; u) < \infty}} \frac{H_0(t', y', u) - H_0(t, y; u)}{1 + H_0(t, y; u)} \rightarrow 0 \quad \text{as } h \downarrow 0, \delta' \downarrow 0.$$

In this section it is not required that the function G_0 (as the function G in § 2) be represented as the logarithm of an exponential moment; the functions G_0 and H_0 need not be smooth.

Limit Theorems On Large Deviations For Markov Stochastic Processes

Stamatis Cambanis, Ioannis Karatzas



Limit Theorems On Large Deviations For Markov Stochastic Processes:

Limit Theorems on Large Deviations for Markov Stochastic Processes A.D. Wentzell, 2012-12-06 In recent decades a new branch of probability theory has been developing intensively namely limit theorems for stochastic processes As compared to classical limit theorems for sums of independent random variables the generalizations are going here in two directions simultaneously First instead of sums of independent variables one considers stochastic processes belonging to certain broad classes Secondly instead of the distribution of a single sum the distribution of the value of a stochastic process at one time point or the joint distribution of the values of a process at a finite number of points one considers distributions in an infinite dimensional function space For stochastic processes constructed starting from sums of independent random variables this is the same as considering the joint distribution of an unboundedly increasing number of sums

Limit Theorems for Large Deviations L. Saulis, V.A. Statulevicius, 2012-12-06 Et moi si j'avais su comment en revenir One service mathematics has rendered the journey would be human race It has put common sense back Jules Verne where it belongs on the topmost shelf next to the dusty canister labelled discarded non The series is divergent therefore we may be sense able to do something with it Eric T Bell On the other hand Mathematics is a tool for thought A highly necessary tool in a world where both feedback and non linearities abound Similarly all kinds of parts of mathematics serve as tools for other parts and for other sciences Applying a simple rewriting rule to the quote on the right above one finds such statements as One service topology has rendered mathematical physics One service logic has rendered computer science One service category theory has rendered mathematics All arguably true And all statements obtainable this way form part of the rationale of this series

Refined Large Deviation Limit Theorems Vladimir Vinogradov, 2023-06-14 This is a developing area of modern probability theory which has applications in many areas This volume is devoted to the systematic study of results on large deviations in situations where Cramér's condition on the finiteness of exponential moments may not be satisfied

Limit Theorems of Probability Theory Yu.V. Prokhorov, V. Statulevicius, 2013-03-14 This book consists of five parts written by different authors devoted to various problems dealing with probability limit theorems The first part Classical Type Limit Theorems for Sums of Independent Random Variables V v Petrov presents a number of classical limit theorems for sums of independent random variables as well as newer related results The presentation dwells on three basic topics the central limit theorem laws of large numbers and the law of the iterated logarithm for sequences of real valued random variables The second part The Accuracy of Gaussian Approximation in Banach Spaces V Bentkus F Götze V Paulauskas and A Rackauskas reviews various results and methods used to estimate the convergence rate in the central limit theorem and to construct asymptotic expansions in infinite dimensional spaces The authors confine themselves to independent and identically distributed random variables They do not strive to be exhaustive or to obtain the most general results their aim is merely to point out the differences from the finite dimensional case and to explain certain new phenomena related to the more complex structure of

Banach spaces Also reflected here is the growing tendency in recent years to apply results obtained for Banach spaces to asymptotic problems of statistics

A Weak Convergence Approach to the Theory of Large Deviations Paul Dupuis, Richard S. Ellis, 2011-09-09 Applies the well developed tools of the theory of weak convergence of probability measures to large deviation analysis a consistent new approach The theory of large deviations one of the most dynamic topics in probability today studies rare events in stochastic systems The nonlinear nature of the theory contributes both to its richness and difficulty This innovative text demonstrates how to employ the well established linear techniques of weak convergence theory to prove large deviation results Beginning with a step by step development of the approach the book skillfully guides reader through models of increasing complexity covering a wide variety of random variable level and process level problems Representation formulas for large deviation type expectations are a key tool and are developed systematically for discrete time problems Accessible to anyone who has a knowledge of measure theory and measure theoretic probability A Weak Convergence Approach to the Theory of Large Deviations is important reading for both students and researchers

Large Deviations for Stochastic Processes Jin Feng, Thomas G. Kurtz, 2006 The book is devoted to the results on large deviations for a class of stochastic processes Following an introduction and overview the material is presented in three parts Part 1 gives necessary and sufficient conditions for exponential tightness that are analogous to conditions for tightness in the theory of weak convergence Part 2 focuses on Markov processes in metric spaces For a sequence of such processes convergence of Fleming's logarithmically transformed nonlinear semigroups is shown to imply the large deviation principle in a manner analogous to the use of convergence of linear semigroups in weak convergence Viscosity solution methods provide applicable conditions for the necessary convergence Part 3 discusses methods for verifying the comparison principle for viscosity solutions and applies the general theory to obtain a variety of new and known results on large deviations for Markov processes In examples concerning infinite dimensional state spaces new comparison principles are de

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Limit Theorems for Random Fields

with Singular Spectrum Nicolai Leonenko, 2012-12-06 This book presents limit theorems for nonlinear functionals of random fields with singular spectrum on the basis of various asymptotic expansions The first chapter treats basic concepts of the spectral theory of random fields some important examples of random processes and fields with singular spectrum and Tauberian and Abelian theorems for covariance function of long memory random fields Chapter 2 is devoted to limit theorems for spherical averages of nonlinear transformations of Gaussian and chi square random fields Chapter 3 summarises some limit theorems for geometric type functionals of random fields Limit theorems for the solutions of Burgers equation with random data via parabolic and hyperbolic rescaling are demonstrated in Chapter 4 Lastly Chapter 5 deals with some problems for statistical analysis of random fields with singular spectrum Audience This book will be of interest to mathematicians who use random fields in engineering or other applications

Stochastic Processes and Operator Calculus on Quantum Groups U. Franz, René Schott, 2013-03-14 This book aims to present several new developments on stochastic processes and operator calculus on quantum groups Topics which are treated include operator calculus dual representations stochastic processes and diffusions Appell polynomials and systems in connection with evolution equations Audience This volume contains introductory material for graduate students who are new to the field as well as more advanced material for specialists in probability theory algebraic structures representation theory mathematical physics and theoretical physics

Analysis and Approximation of Rare Events Amarjit Budhiraja, Paul Dupuis, 2019-08-10 This book presents broadly applicable methods for the large deviation and moderate deviation analysis of discrete and continuous time stochastic systems A feature of the book is the systematic use of variational representations for quantities of interest such as normalized logarithms of probabilities and expected values By characterizing a large deviation principle in terms of Laplace asymptotics one converts the proof of large deviation limits into the convergence of variational representations These features are illustrated through their application to a broad range of discrete and continuous time models including stochastic partial differential equations processes with discontinuous statistics occupancy models and many others The tools used in the large deviation analysis also turn out to be useful in understanding Monte Carlo schemes for the numerical approximation of the same probabilities and expected values This connection is illustrated through the design and analysis of importance sampling and splitting schemes for rare event estimation The book assumes a solid background in weak convergence of probability measures and stochastic analysis and is suitable for advanced graduate students postdocs and researchers

Large Deviations Frank Hollander, 2000 This volume offers an introduction to large deviations It is divided into two parts theory and applications Basic large deviation theorems are presented for iid sequences Markov sequences and sequences with moderate dependence The rate function is computed explicitly The theory is explained without too much emphasis on technicalities Also included is an outline of general definitions and theorems The goal is to expose the unified theme that gives large deviation theory its overall structure which can be made to work in many concrete cases The section

on applications focuses on recent work in statistical physics and random media This book contains 60 exercises with solutions that should elucidate the content and engage the reader Prerequisites for the book are a strong background in probability and analysis and some knowledge of statistical physics It would make an excellent textbook for a special topics course in large deviations **Limit Theorems for Randomly Stopped Stochastic Processes** Dmitrii S.

Silvestrov,2012-12-06 Limit theorems for stochastic processes are an important part of probability theory and mathematical statistics and one model that has attracted the attention of many researchers working in the area is that of limit theorems for randomly stopped stochastic processes This volume is the first to present a state of the art overview of this field with many of the results published for the first time It covers the general conditions as well as the basic applications of the theory and it covers and demystifies the vast and technically demanding Russian literature in detail A survey of the literature and an extended bibliography of works in the area are also provided The coverage is thorough streamlined and arranged according to difficulty for use as an upper level text if required It is an essential reference for theoretical and applied researchers in the fields of probability and statistics that will contribute to the continuing extensive studies in the area and remain relevant for years to come *Large Deviations* S. R. S. Varadhan,2016-12-08 The theory of large deviations deals with rates at which probabilities of certain events decay as a natural parameter in the problem varies This book which is based on a graduate course on large deviations at the Courant Institute focuses on three concrete sets of examples i diffusions with small noise and the exit problem ii large time behavior of Markov processes and their connection to the Feynman Kac formula and the related large deviation behavior of the number of distinct sites visited by a random walk and iii interacting particle systems their scaling limits and large deviations from their expected limits For the most part the examples are worked out in detail and in the process the subject of large deviations is developed The book will give the reader a flavor of how large deviation theory can help in problems that are not posed directly in terms of large deviations The reader is assumed to have some familiarity with probability Markov processes and interacting particle systems *Asymptotic Analysis for Periodic Structures* Alain Bensoussan,Jacques-Louis Lions,George Papanicolaou,2011-10-26 This is a reprinting of a book originally published in 1978 At that time it was the first book on the subject of homogenization which is the asymptotic analysis of partial differential equations with rapidly oscillating coefficients and as such it sets the stage for what problems to consider and what methods to use including probabilistic methods At the time the book was written the use of asymptotic expansions with multiple scales was new especially their use as a theoretical tool combined with energy methods and the construction of test functions for analysis with weak convergence methods Before this book multiple scale methods were primarily used for non linear oscillation problems in the applied mathematics community not for analyzing spatial oscillations as in homogenization In the current printing a number of minor corrections have been made and the bibliography was significantly expanded to include some of the most important recent references This book gives systematic introduction of multiple scale

methods for partial differential equations including their original use for rigorous mathematical analysis in elliptic parabolic and hyperbolic problems and with the use of probabilistic methods when appropriate The book continues to be interesting and useful to readers of different backgrounds both from pure and applied mathematics because of its informal style of introducing the multiple scale methodology and the detailed proofs

Modern Problems of Stochastic Analysis and Statistics Vladimir Panov, 2017-11-21 This book brings together the latest findings in the area of stochastic analysis and statistics The individual chapters cover a wide range of topics from limit theorems Markov processes nonparametric methods actuarial science population dynamics and many others The volume is dedicated to Valentin Konakov head of the International Laboratory of Stochastic Analysis and its Applications on the occasion of his 70th birthday Contributions were prepared by the participants of the international conference of the international conference Modern problems of stochastic analysis and statistics held at the Higher School of Economics in Moscow from May 29 June 2 2016 It offers a valuable reference resource for researchers and graduate students interested in modern stochastics

Encyclopaedia of Mathematics Michiel Hazewinkel, 2013-12-01 This ENCYCLOPAEDIA OF MATHEMATICS aims to be a reference work for all parts of mathematics It is a translation with updates and editorial comments of the Soviet Mathematical Encyclopaedia published by Soviet Encyclopaedia Publishing House in five volumes in 1977 1985 The annotated translation consists of ten volumes including a special index volume There are three kinds of articles in this ENCYCLOPAEDIA First of all there are survey type articles dealing with the various main directions in mathematics where a rather fine subdivision has been used The main requirement for these articles has been that they should give a reasonably complete up to date account of the current state of affairs in these areas and that they should be maximally accessible On the whole these articles should be understandable to mathematics students in their first specialization years to graduates from other mathematical areas and depending on the specific subject to specialists in other domains of science engineers and teachers of mathematics These articles treat their material at a fairly general level and aim to give an idea of the kind of problems techniques and concepts involved in the area in question They also contain background and motivation rather than precise statements of precise theorems with detailed definitions and technical details on how to carry out proofs and constructions The second kind of article of medium length contains more detailed concrete problems results and techniques

Compound Renewal Processes A. A. Borovkov, 2022-06-30 Compound renewal processes CRPs are among the most ubiquitous models arising in applications of probability At the same time they are a natural generalization of random walks the most well studied classical objects in probability theory This monograph written for researchers and graduate students presents the general asymptotic theory and generalizes many well known results concerning random walks The book contains the key limit theorems for CRPs functional limit theorems integro local limit theorems large and moderately large deviation principles for CRPs in the state space and in the space of trajectories including large deviation principles in boundary crossing problems for CRPs with an explicit form of

the rate functionals and an extension of the invariance principle for CRPs to the domain of moderately large and small deviations Applications establish the key limit laws for Markov additive processes including limit theorems in the domains of normal and large deviations

Stochastic Processes and Related Topics Stamatis Cambanis, Ioannis Karatzas, 1998 In the last twenty years extensive research has been devoted to a better understanding of the stable and other closely related infinitely divisible models Stamatis Cambanis a distinguished educator and researcher played a special leadership role in the development of these research efforts particularly related to stable processes from the early seventies until his untimely death in April 95 This commemorative volume consists of a collection of research articles devoted to reviewing the state of the art of this and other rapidly developing research and to explore new directions of research in these fields The volume is a tribute to the Life and Work of Stamatis by his students friends and colleagues whose personal and professional lives he has deeply touched through his generous insights and dedication to his profession Before the idea of this volume was conceived two conferences were held in the memory of Stamatis The first was organized by the University of Athens and the Athens University of Economics and was held in Athens during December 18 19 1995 The second was a significant part of a Special IMS meeting held at the campus of the University of North Carolina at Chapel Hill during October 17 19 1996 It is the selfless effort of several people that brought about these conferences We believe that this is an appropriate place to acknowledge their effort and on behalf of all the participants we extend sincere thanks to all these persons

Probability Theory, Random Processes and Mathematical Statistics Y. Rozanov, 2012-12-06 Probability Theory Theory of Random Processes and Mathematical Statistics are important areas of modern mathematics and its applications They develop rigorous models for a proper treatment for various random phenomena which we encounter in the real world They provide us with numerous tools for an analysis prediction and ultimately control of random phenomena Statistics itself helps with choice of a proper mathematical model e.g. by estimation of unknown parameters on the basis of statistical data collected by observations This volume is intended to be a concise textbook for a graduate level course with carefully selected topics representing the most important areas of modern Probability Random Processes and Statistics The first part Ch 1 3 can serve as a self contained elementary introduction to Probability Random Processes and Statistics It contains a number of relatively simple and typical examples of random phenomena which allow a natural introduction of general structures and methods Only knowledge of elements of real complex analysis linear algebra and ordinary differential equations is required here The second part Ch 4 6 provides a foundation of Stochastic Analysis gives information on basic models of random processes and tools to study them Here a familiarity with elements of functional analysis is necessary Our intention to make this course fast moving made it necessary to present important material in a form of examples

American Mathematical Society Translations United States. Office of Naval Research, 2001-04-10 The articles in this collection present new results in combinatorics algebra algebraic geometry dynamical systems analysis and probability Of particular interest is the survey

article by A N Kirillov devoted to combinatorics of Young diagrams and related problems of representation theory Also included are articles devoted to the eightieth birthday of renowned Russian mathematician V A Rokhlin Remembrances of V A Rokhlin by I R Shafarevich and An Unfinished Project of V A Rokhlin by V N Sudakov The results ideas and methods given in the book will be of interest to a broad range of specialists

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