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RANDOM WALKS WITH STOCHASTICALLY BOUNDED INCREMENTS: RENEWAL THEORY VIA FOURIER ANALYSIS

By

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Summary. Random walks $S_N=(S_n)_{n\geq 0}$ with stochastically bounded increments $X_0, X_1, \cdots$ have been introduced in [2], [3] as natural generalizations of those with i.i.d. increments. In this article we present Blackwell-type renewal theorems proved by means of Fourier analysis. In the special case of independent $X_0, X_1, \cdots$ these results lead to generalizations of earlier ones in the literature, notably in [3] where proofs were based on coupling technique which is a purely probabilistic device. As a further application we prove Blackwell's renewal theorem for certain random walks with stationary 1-dependent increments that appear in Markov renewal theory as subsequences of Markov random walks.

1. Introduction

Random walks with stochastically lower and/or upper bounded increments, see Definition 1.1 below, are a natural generalization of those with i.i.d. increments and have been introduced in [2], [3]. Certain drift bounds describing the mean growth of these random walks over finite remote time intervals as well as related characterization results are given in [2], whereas [3] is devoted to the proof of Blackwell-type renewal theorems under appropriate additional assumptions. Of principal importance there is the use of the coupling method, a probabilistic device which has regained great importance since the seventies. In this article we will derive Blackwell-type renewal theorems via the more classical approach based upon Fourier analysis.

We keep the basic notation of [2] and [3] which is briefly summarized below. Let $X_N=(X_n)_{n\geq 0}$ be a sequence of real-valued, integrable random variables on a probability space $(\Omega, \mathcal{F}, P)$ with associated random walk S_N, defined through $S_n=X_0+\cdots+X_n$ for all $n\in\mathbb{N}$. Let $\mathcal{F}_N$ be an arbitrary filtration to

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Random Walks With Stationary Increments And Renewal Theory

Vladimir V. Kalashnikov

Random Walks With Stationary Increments And Renewal Theory:

Random Walks with Stationary Increments and Renewal Theory H. C. P. Berbee,1979 **Renewal Theory for Perturbed Random Walks and Similar Processes** Alexander Iksanov,2016-12-09 This book offers a detailed review of perturbed random walks perpetuities and random processes with immigration Being of major importance in modern probability theory both theoretical and applied these objects have been used to model various phenomena in the natural sciences as well as in insurance and finance The book also presents the many significant results and efficient techniques and methods that have been worked out in the last decade The first chapter is devoted to perturbed random walks and discusses their asymptotic behavior and various functionals pertaining to them including supremum and first passage time The second chapter examines perpetuities presenting results on continuity of their distributions and the existence of moments as well as weak convergence of divergent perpetuities Focusing on random processes with immigration the third chapter investigates the existence of moments describes long time behavior and discusses limit theorems both with and without scaling Chapters four and five address branching random walks and the Bernoulli sieve respectively and their connection to the results of the previous chapters With many motivating examples this book appeals to both theoretical and applied probabilists Stopped Random Walks Allan Gut,2009-04-03 Classical probability theory provides information about random walks after a fixed number of steps For applications however it is more natural to consider random walks evaluated after a random number of steps Examples are sequential analysis queueing theory storage and inventory theory insurance risk theory reliability theory and the theory of counters Stopped Random Walks Limit Theorems and Applications shows how this theory can be used to prove limit theorems for renewal counting processes first passage time processes and certain two dimensional random walks and to how these results are useful in various applications This second edition offers updated content and an outlook on further results extensions and generalizations A new chapter examines nonlinear renewal processes in order to present the analagous theory for perturbed random walks modeled as a random walk plus noise **Asymptotic Theory of Weakly Dependent Random Processes** Emmanuel Rio,2017-04-13 Ces notes sont consacr es aux in galit s et aux th or mes limites classiques pour les suites de variables al atoires absolument r guli res ou fortement m langeantes au sens de Rosenblatt Le but poursuivi est de donner des outils techniques pour l tude des processus faiblement d pendants aux statisticiens ou aux probabilistes travaillant sur ces processus *Stochastic Processes: Theory and Methods* D N Shanbhag,Calyampudi Radhakrishna Rao,2001 This volume in the series contains chapters on areas such as pareto processes branching processes inference in stochastic processes Poisson approximation Levy processes and iterated random maps and some classes of Markov processes Other chapters cover random walk and fluctuation theory a semigroup representation and asymptomatic behavior of certain statistics of the Fisher Wright Moran coalescent continuous time ARMA processes record sequence and their applications stochastic networks with product form equilibrium and stochastic processes in insurance and finance Other

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develops and analyses mathematical models for phenomena that evolve in time and influence each another It provides a better understanding of the structure and asymptotic behaviour of stochastic processes Two approaches are taken Firstly the authors present tools for dealing with the dependent structures used to obtain normal approximations Secondly they apply normal approximations to various examples The main tools consist of inequalities for dependent sequences of random variables leading to limit theorems including the functional central limit theorem and functional moderate deviation principle The results point out large classes of dependent random variables which satisfy invariance principles making possible the statistical study of data coming from stochastic processes both with short and long memory The dependence structures considered throughout the book include the traditional mixing structures martingale like structures and weakly negatively dependent structures which link the notion of mixing to the notions of association and negative dependence Several applications are carefully selected to exhibit the importance of the theoretical results They include random walks in random scenery and determinantal processes In addition due to their importance in analysing new data in economics linear processes with dependent innovations will also be considered and analysed *Markov Chains and Stochastic Stability* Sean Meyn,Richard L. Tweedie,2009-04-02 New up to date edition of this influential classic on Markov chains in general state spaces Proofs are rigorous and concise the range of applications is broad and knowledgeable and key ideas are accessible to practitioners with limited mathematical background New commentary by Sean Meyn including updated references reflects developments since 1996 **Topics on Regenerative Processes** Vladimir V. Kalashnikov,1994-06-27 Regenerative processes are a popular subject in pure and applied probability as well as in engineering particularly simulation This book provides important insight into new methods for investigating regenerative processes Quantitative estimates play the key role in the book and all developed methods support possibilities for obtaining such estimates including probability metrics test functions crossing and coupling These methods are applied to a variety of problems such as Markov chains simulation queueing systems storage and reliability The book illustrates a unique application of the theory of probability metrics for examining regenerative processes and it elaborates on the criteria required for uniform in time stability of wide sense regenerative processes New accurate bounds of distribution functions of first occurrence times for regenerative models are also presented Measure Theory and Probability Theory Krishna B. Athreya,Soumendra N. Lahiri,2006-11-24 This book arose out of two graduate courses that the authors have taught duringthepastseveralyears the rstonebeingonmeasuretheoryfollowed by the second one on advanced probability theory The traditional approach to a rst course in measure theory such as in Royden 1988 is to teach the Lebesgue measure on the real line then the p di erentation theorems of Lebesgue L spaces on R and do general m sure at the end of the course with one main application to the construction of product measures This approach does have the pedagogic advantage of seeing one concrete case rst before going to the general one But this also has the disadvantage in making many students perspective on m sure theory somewhat

narrow It leads them to think only in terms of the Lebesgue measure on the real line and to believe that measure theory is intimately tied to the topology of the real line As students of statistics probability physics engineering economics and biology know very well there are mass distributions that are typically nonuniform and hence it is useful to gain a general perspective This book attempts to provide that general perspective right from the beginning The opening chapter gives an informal introduction to measure and integration theory It shows that the notions of algebra of sets and countable additivity of a set function are dictated by certain very na ral approximation procedures from practical applications and that they are not just some abstract ideas *Theory and Applications of Long-Range Dependence* Paul Doukhan,George Oppenheim,Murad Taqqu,2002-12-13 The area of data analysis has been greatly affected by our computer age For example the issue of collecting and storing huge data sets has become quite simplified and has greatly affected such areas as finance and telecommunications Even non specialists try to analyze data sets and ask basic questions about their structure One such question is whether one observes some type of invariance with respect to scale a question that is closely related to the existence of long range dependence in the data This important topic of long range dependence is the focus of this unique work written by a number of specialists on the subject The topics selected should give a good overview from the probabilistic and statistical perspective Included will be articles on fractional Brownian motion models inequalities and limit theorems periodic long range dependence parametric semiparametric and non parametric estimation long memory stochastic volatility models robust estimation and prediction for long range dependence sequences For those graduate students and researchers who want to use the methodology and need to know the tricks of the trade there will be a special section called Mathematical Techniques Topics in the first part of the book are covered from probabilistic and statistical perspectives and include fractional Brownian motion models inequalities and limit theorems periodic long range dependence parametric semiparametric and non parametric estimation long memory stochastic volatility models robust estimation prediction for long range dependence sequences The reader is referred to more detailed proofs if already found in the literature The last part of the book is devoted to applications in the areas of simulation estimation and wavelet techniques traffic in computer networks econometry and finance multifractal models and hydrology Diagrams and illustrations enhance the presentation Each article begins with introductory background material and is accessible to mathematicians a variety of practitioners and graduate students The work serves as a state of the art reference or graduate seminar text Empirical Process Techniques for Dependent Data Herold Dehling,Thomas Mikosch,Michael Sörensen,2012-12-06 Empirical process techniques for independent data have been used for many years in statistics and probability theory These techniques have proved very useful for studying asymptotic properties of parametric as well as non parametric statistical procedures Recently the need to model the dependence structure in data sets from many different subject areas such as finance insurance and telecommunications has led to new developments concerning the empirical distribution function and the empirical process

for dependent mostly stationary sequences This work gives an introduction to this new theory of empirical process techniques which has so far been scattered in the statistical and probabilistic literature and surveys the most recent developments in various related fields Key features A thorough and comprehensive introduction to the existing theory of empirical process techniques for dependent data Accessible surveys by leading experts of the most recent developments in various related fields Examines empirical process techniques for dependent data useful for studying parametric and non parametric statistical procedures Comprehensive bibliographies An overview of applications in various fields related to empirical processes e g spectral analysis of time series the bootstrap for stationary sequences extreme value theory and the empirical process for mixing dependent observations including the case of strong dependence To date this book is the only comprehensive treatment of the topic in book literature It is an ideal introductory text that will serve as a reference or resource for classroom use in the areas of statistics time series analysis extreme value theory point process theory and applied probability theory Contributors P Ango Nze M A Arcones I Berkes R Dahlhaus J Dedecker H G Dehling Applied Probability and Stochastic Processes V. C. Joshua,S. R. S. Varadhan,Vladimir M. Vishnevsky,2020-08-29 This book gathers selected papers presented at the International Conference on Advances in Applied Probability and Stochastic Processes held at CMS College Kerala India on 7 10 January 2019 It showcases high quality research conducted in the field of applied probability and stochastic processes by focusing on techniques for the modelling and analysis of systems evolving with time Further it discusses the applications of stochastic modelling in queuing theory reliability inventory financial mathematics operations research and more This book is intended for a broad audience ranging from researchers interested in applied probability stochastic modelling with reference to queuing theory inventory and reliability to those working in industries such as communication and computer networks distributed information systems next generation communication systems intelligent transportation networks and financial markets **Probability Towards 2000** L. Accardi,C.C. Heyde,2012-12-06 Senior probabilists from around the world with widely differing specialities gave their visions of the state of their specialty why they think it is important and how they think it will develop in the new millenium The volume includes papers given at a symposium at Columbia University in 1995 but papers from others not at the meeting were added to broaden the coverage of areas All papers were refereed *Dependence in Probability and Statistics* Patrice Bertail,Paul Doukhan,Philippe Soulier,2006-09-24 This book gives an account of recent developments in the field of probability and statistics for dependent data It covers a wide range of topics from Markov chain theory and weak dependence with an emphasis on some recent developments on dynamical systems to strong dependence in times series and random fields There is a section on statistical estimation problems and specific applications The book is written as a succession of papers by field specialists alternating general surveys mostly at a level accessible to graduate students in probability and statistics and more general research papers mainly suitable to researchers in the field Probability Allan Gut,2013 This book covers inequalities characteristic

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