

Large Deviations for Performance Analysis

**Queues, communications,
and computing**

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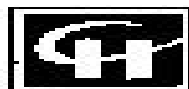
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Large Deviations For Performance Analysis Queues Communication And Computing

Riccardo Gatto

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Large Deviations For Performance Analysis Queues Communication And Computing:

Large Deviations For Performance Analysis Adam Shwartz, Alan Weiss, 1995-09-01 This book consists of two synergistic parts. The first half develops the theory of large deviations from the beginning iid random variables through recent results on the theory for processes with boundaries keeping to a very narrow path continuous time discrete state processes. By developing only what is needed for the applications, the theory is kept to a manageable level both in terms of length and in terms of difficulty. Within its scope, the treatment is detailed, comprehensive, and self-contained. As the book shows, there are sufficiently many interesting applications of jump Markov processes to warrant a special treatment. The second half is a collection of applications developed at Bell Laboratories. The applications cover large areas of the theory of communication networks: circuit switched transmission, packet transmission, multiple access channels, and the M/M/1 queue. Aspects of parallel computation are covered as well, including basics of job allocation, rollback based parallel simulation, assorted priority queueing models that might be used in performance models of various computer architectures, and asymptotic coupling of processors. These applications are thoroughly analyzed using the tools developed in the first half of the book. Features: A transient analysis of the M/M/1 queue, a new analysis of an Aloha model using Markov modulated theory, new results for Erlang's model, new results for the AMS model, analysis of server queue join the shorter queue, and other simple priority queues, and a simple analysis of the Flatto-Hahn-Wright model of processor sharing.

Large Deviations For Performance Analysis Alan Weiss, Adam Shwartz, 2019-03-07 Originally published in 1995, *Large Deviations for Performance Analysis* consists of two synergistic parts. The first half develops the theory of large deviations from the beginning through recent results on the theory for processes with boundaries, keeping to a very narrow path: continuous time, discrete state processes. By developing only what is needed for the applications, the theory is kept to a manageable level both in terms of length and in terms of difficulty. Within its scope, the treatment is detailed, comprehensive, and self-contained. As the book shows, there are sufficiently many interesting applications of jump Markov processes to warrant a special treatment. The second half is a collection of applications developed at Bell Laboratories. The applications cover large areas of the theory of communication networks: circuit switched transmission, packet transmission, multiple access channels, and the M/M/1 queue. Aspects of parallel computation are covered as well, including basics of job allocation, rollback based parallel simulation, assorted priority queueing models that might be used in performance models of various computer architectures, and asymptotic coupling of processors. These applications are thoroughly analysed using the tools developed in the first half of the book.

Large Deviations for Gaussian Queues Michel Mandjes, 2007-04-30 In recent years, the significance of Gaussian processes to communication networks has grown considerably. The inherent flexibility of the Gaussian traffic model enables the analysis in a single mathematical framework of systems with both long range and short range dependent input streams. *Large Deviations for Gaussian Queues* demonstrates how the Gaussian traffic model arises naturally and how the analysis of the corresponding

queuing model can be performed The text provides a general introduction to Gaussian queues and surveys recent research into the modelling of communications networks Coverage includes Discussion of the theoretical concepts and practical aspects related to Gaussian traffic models Analysis of recent research asymptotic results for Gaussian queues both in the large buffer and many sources regime An emphasis on rare event analysis relying on a variety of asymptotic techniques Examination of single node FIFO queuing systems as well as queues operating under more complex scheduling disciplines and queuing networks A set of illustrative examples that directly relate to important practical problems in communication networking A large collection of instructive exercises and accompanying solutions Large Deviations for Gaussian Queues assumes minimal prior knowledge It is ideally suited for postgraduate students in applied probability operations research computer science and electrical engineering The book s self contained style makes it perfect for practitioners in the communications networking industry and for researchers in related areas

Performance Guarantees in Communication Networks Cheng-Shang Chang, 2012-12-06 Providing performance guarantees is one of the most important issues for future telecommunication networks This book describes theoretical developments in performance guarantees for telecommunication networks from the last decade Written for the benefit of graduate students and scientists interested in telecommunications network performance this book consists of two parts The first introduces the recently developed filtering theory for providing deterministic hard guarantees such as bounded delay and queue length The filtering theory is developed under the min plus algebra where one replaces the usual addition with the min operator and the usual multiplication with the addition operator As in the classical linear system theory the filtering theory treats an arrival process or a departure process as a signal and a network element as a system Network elements including traffic regulators and servers can be modelled as linear filters under the min plus algebra and they can be joined by concatenation filter bank summation and feedback to form a composite network element The problem of providing deterministic guarantees is equivalent to finding the impulse response of composite network elements This section contains material on s r calculus Filtering theory for deterministic traffic regulation service guarantees and networks with variable length packets Traffic specification Networks with multiple inputs and outputs Constrained traffic regulation The second part of the book addresses stochastic soft guarantees focusing mainly on tail distributions of queue lengths and packet loss probabilities and contains material on s q r q calculus and q envelope rates The large deviation principle The theory of effective bandwidth The mathematical theory for stochastic guarantees is the theory of effective bandwidth Based on the large deviation principle the theory of effective bandwidth provides approximations for the bandwidths required to meet stochastic guarantees for both short range dependent inputs and long range dependent inputs

A Weak Convergence Approach to the Theory of Large Deviations Paul Dupuis, Richard S. Ellis, 1997-02-27 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

improbability 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 readers 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

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

Analysis of Communication Networks: Call Centres, Traffic and Performance David R. McDonald, Stephen Robert Edward Turner, 2000 This volume consists of the proceedings of the Workshop on Analysis and Simulation of Communication Networks held at The Fields Institute Toronto The workshop was divided into two main themes entitled Stability and Load Balancing of a Network of Call Centres and Traffic and Performance The call centre industry is large and fast growing In order to provide top notch customer service it needs good mathematical models The first part of the volume focuses on probabilistic issues involved in optimizing the performance of a call centre While this was the motivating application many of the papers are also applicable to more general distributed queueing networks The second part of the volume discusses the characterization of traffic streams and how to estimate their impact on the performance of a queueing system The performance of queues under worst case traffic flows or flows with long bursts is treated These studies are motivated by questions about buffer dimensioning and call admission control in ATM or IP networks This volume will serve researchers as a comprehensive state of the art reference source on developments in this rapidly expanding field

Simulation of Communication Systems Michel C. Jeruchim, Philip Balaban, K. Sam Shanmugan, 2000-10-31 Since the first edition of this

book was published seven years ago the field of modeling and simulation of communication systems has grown and matured in many ways and the use of simulation as a day to day tool is now even more common practice With the current interest in digital mobile communications a primary area of application of modeling and simulation is now in wireless systems of a different flavor from the traditional ones This second edition represents a substantial revision of the first partly to accommodate the new applications that have arisen New chapters include material on modeling and simulation of nonlinear systems with a complementary section on related measurement techniques channel modeling and three new case studies a consolidated set of problems is provided at the end of the book

30th Biennial Symposium on Communications 2021 Ha Nguyen, Long Le, Pradeepa Yahampath, Ebrahim Bedeer Mohamed, 2022-10-20 The book presents the proceedings of the 30th Biennial Symposium on Communications 2021 BSC21 a prestigious international research conference in communications information theory and signal processing Started in 1962 by Queen's University Canada the Symposium is now presented by the Canadian Society of Information Theory Its 30th edition was hosted virtually by The University of Saskatchewan and held in Saskatoon from June 28 to 30 2021 Topics include Communication and Information Theory Coding and Signal Processing for Communications and Multiple Antenna Systems and Cooperative Communications

The Fundamental Role of Teletraffic in the Evolution of Telecommunications Networks J. Labetoulle, J.W. Roberts, 2013-10-22 The International Teletraffic Congress ITC is a recognized international organization taking part in the work of the International Telecommunications Union The congress traditionally deals with the development of teletraffic theory and its applications to the design planning and operation of telecommunication systems networks and services The contents of ITC 14 illustrate the important role of teletraffic in the current period of rapid evolution of telecommunication networks A large number of papers address the teletraffic issues behind developments in broadband communications and ATM technology The extension of possibilities for user mobility and personal communications together with the generalization of common channel signalling and the provision of new intelligent network services are further extremely significant developments whose teletraffic implications are explored in a number of contributions ITC 14 also addresses traditional teletraffic subjects proposing enhancements to traffic engineering practices for existing circuit and packet switched telecommunications networks and making valuable original contributions to the fundamental mathematical tools on which teletraffic theory is based The contents of these Proceedings accurately reflect the extremely wide scope of the ITC extending from basic mathematical theory to day to day traffic engineering practices and constitute the state of the art in 1994 of one of the fundamental telecommunications sciences

Engineering Internet QoS Sanjay Jha, Mahbub Hassan, 2002 From the basics to the most advanced quality of service QoS concepts this all encompassing first of its kind book offers an in depth understanding of the latest technical issues raised by the emergence of new types classes and qualities of Internet services The book provides end to end QoS guidance for real time multimedia communications over the Internet It offers you a multiplicity of hands on

examples and simulation script support and shows you where and when it is preferable to use these techniques for QoS support in networks and Internet traffic with widely varying characteristics and demand profiles This practical resource discusses key standards and protocols including real time transport resource reservation and integrated and differentiated service models policy based management and mobile wireless QoS The book features numerous examples simulation results and graphs that illustrate important concepts and pseudo codes are used to explain algorithms Case studies based on freely available Linux FreeBSD systems are presented to show you how to build networks supporting Quality of Service Online support material including presentation foils lab exercises and additional exercises are available to text adoptors

Stochastic Modeling and Analysis of Manufacturing Systems David D. Yao, 2012-12-06 Manufacturing systems have become increasingly complex over recent years This volume presents a collection of chapters which reflect the recent developments of probabilistic models and methodologies that have either been motivated by manufacturing systems research or been demonstrated to have significant potential in such research The editor has invited a number of leading experts to present detailed expositions of specific topics These include Jackson networks fluid models diffusion and strong approximations the GSMP framework stochastic convexity and majorization perturbation analysis scheduling via Brownian models and re entrant lines and dynamic scheduling Each chapter has been written with graduate students in mind and several have been used in graduate courses that teach the modeling and analysis of manufacturing systems

Stationary Stochastic Models: An Introduction Riccardo Gatto, 2022-06-23 This volume provides a unified mathematical introduction to stationary time series models and to continuous time stationary stochastic processes The analysis of these stationary models is carried out in time domain and in frequency domain It begins with a practical discussion on stationarity by which practical methods for obtaining stationary data are described The presented topics are illustrated by numerous examples Readers will find the following covered in a comprehensive manner At the end some selected topics such as stationary random fields simulation of Gaussian stationary processes time series for planar directions large deviations approximations and results of information theory are presented A detailed appendix containing complementary materials will assist the reader with many technical aspects of the book

Risk and Insurance Søren Asmussen, Mogens Steffensen, 2020-04-17 This textbook provides a broad overview of the present state of insurance mathematics and some related topics in risk management financial mathematics and probability Both non life and life aspects are covered The emphasis is on probability and modeling rather than statistics and practical implementation Aimed at the graduate level pointing in part to current research topics it can potentially replace other textbooks on basic non life insurance mathematics and advanced risk management methods in non life insurance Based on chapters selected according to the particular topics in mind the book may serve as a source for introductory courses to insurance mathematics for non specialists advanced courses for actuarial students or courses on probabilistic aspects of risk It will also be useful for practitioners and students researchers in related

areas such as finance and statistics who wish to get an overview of the general area of mathematical modeling and analysis in insurance

Elements of Information Theory Thomas M. Cover, Joy A. Thomas, 2012-11-28 The latest edition of this classic is updated with new problem sets and material The Second Edition of this fundamental textbook maintains the book's tradition of clear thought provoking instruction Readers are provided once again with an instructive mix of mathematics physics statistics and information theory All the essential topics in information theory are covered in detail including entropy data compression channel capacity rate distortion network information theory and hypothesis testing The authors provide readers with a solid understanding of the underlying theory and applications Problem sets and a telegraphic summary at the end of each chapter further assist readers The historical notes that follow each chapter recap the main points The Second Edition features Chapters reorganized to improve teaching 200 new problems New material on source coding portfolio theory and feedback capacity Updated references Now current and enhanced the Second Edition of Elements of Information Theory remains the ideal textbook for upper level undergraduate and graduate courses in electrical engineering statistics and telecommunications

The Fundamentals of Heavy Tails Jayakrishnan Nair, Adam Wierman, Bert Zwart, 2022-06-09 An accessible yet rigorous package of probabilistic and statistical tools for anyone who must understand or model extreme events

Encyclopedia of Environmetrics Abdel H. El-Shaarawi, Walter W. Piegorsch, 2002 A comprehensive overview of environmetric research and its applications Environmetrics covers the development and application of quantitative methods in the environmental sciences It provides essential tools for understanding predicting and controlling the impacts of agents both man made and natural which affect the environment Basic and applied research in this area covers a broad range of topics Primary among these are the quantitative sciences such as statistics probability and applied mathematics chemometrics and econometrics Applications are also important for example in ecology and environmental biology public health atmospheric science geology engineering risk management and regulatory governmental policy amongst others Divided into 12 sections the Encyclopedia brings together over 600 detailed articles which have been carefully selected and reviewed through the collaborative efforts of the Editors in Chief and the appropriate Section Editor Presented in alphabetical order all the articles will include an explanatory introduction extensive cross referencing and an up to date bibliography providing literature references for further reading Presenting state of the art information in a readable highly accessible style the scope and coverage provided by the Encyclopedia of Environmetrics will ensure its place as the landmark reference for the many scientists educators and decision makers working across this multidisciplinary field An essential reference tool for university libraries research laboratories government institutions and consultancies concerned with the environmental sciences the Encyclopedia of Environmetrics brings together for the first time comprehensive coverage of the full range of topics techniques and applications covered by this multidisciplinary field There is currently no central reference source which addresses the needs of this multidisciplinary community This new Encyclopedia will fill this gap by providing a

comprehensive source of relevant fundamental concepts in environmetric research development and applications for statisticians mathematicians economists environmentalists ecologist government officials and policy makers *Rare Event Simulation using Monte Carlo Methods* Gerardo Rubino, Bruno Tuffin, 2009-03-18 In a probabilistic model a rare event is an event with a very small probability of occurrence The forecasting of rare events is a formidable task but is important in many areas For instance a catastrophic failure in a transport system or in a nuclear power plant the failure of an information processing system in a bank or in the communication network of a group of banks leading to financial losses Being able to evaluate the probability of rare events is therefore a critical issue Monte Carlo Methods the simulation of corresponding models are used to analyze rare events This book sets out to present the mathematical tools available for the efficient simulation of rare events Importance sampling and splitting are presented along with an exposition of how to apply these tools to a variety of fields ranging from performance and dependability evaluation of complex systems typically in computer science or in telecommunications to chemical reaction analysis in biology or particle transport in physics Graduate students researchers and practitioners who wish to learn and apply rare event simulation techniques will find this book beneficial

Large deviations for performance analysis Adam Shwartz, Alan Weiss, Tekhniyon, Makhon tekhnologi le-Yisra'el. Department of Electrical Engineering, 1996 **Network Performance Engineering** Demetres D. Kouvatsos, 2011-05-09 During recent years a great deal of progress has been made in performance modelling and evaluation of the Internet towards the convergence of multi service networks of diverging technologies supported by internetworking and the evolution of diverse access and switching technologies The 44 chapters presented in this handbook are revised invited works drawn from PhD courses held at recent HETNETs International Working Conferences on Performance Modelling and Evaluation of Heterogeneous Networks They constitute essential introductory material preparing the reader for further research and development in the field of performance modelling analysis and engineering of heterogeneous networks and of next and future generation Internets The handbook aims to unify relevant material already known but dispersed in the literature introduce the readers to unfamiliar and unexposed research areas and generally illustrate the diversity of research found in the high growth field of convergent heterogeneous networks and the Internet The chapters have been broadly classified into 12 parts covering the following topics Measurement Techniques Traffic Modelling and Engineering Queueing Systems and Networks Analytic Methodologies Simulation Techniques Performance Evaluation Studies Mobile Wireless and Ad Hoc Networks Optical Networks QoS Metrics and Algorithms All IP Convergence and Networking Network Management and Services and Overlay Networks

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