

Probability Markov Chains Queues And Simulation The Mathematical Basis Of Performance Modeling By Stewart William J 2009 Hardcover

This book is an introduction to the modern approach to the theory of Markov chains. The main goal of this approach is to determine the rate of convergence of a Markov chain to the stationary distribution as a function of the size and geometry of the state space. The authors develop the key tools for estimating convergence times, including coupling, strong stationary times, and spectral methods. Whenever possible, probabilistic methods are emphasized. The book includes many examples and provides brief introductions to some central models of statistical mechanics. Also provided are accounts of random walks on networks, including hitting and cover times, and analyses of several methods of shuffling cards. As a prerequisite, the authors assume a modest understanding of probability theory and linear algebra at an undergraduate level. Markov Chains and Mixing Times is meant to bring the excitement of this active area of research to a wide audience.

This textbook provides a comprehensive introduction to probability and stochastic processes, and shows how these subjects may be applied in computer performance modelling. The author's aim is to derive the theory in a way that combines its formal, intuitive, and applied aspects so that students may apply this indispensable tool in a variety of different settings. Readers are assumed to be familiar with elementary linear algebra and calculus, including the concept of limit, but otherwise this book provides a self-contained approach suitable for graduate or advanced undergraduate students. The first half of the book covers the basic concepts of probability including expectation, random variables, and fundamental theorems. In the second half of the book the reader is introduced to stochastic processes. Subjects covered include renewal processes, queueing theory, Markov processes, and reversibility as it applies to networks of queues. Examples and applications are drawn from problems in computer performance modelling.

This introductory textbook is designed for a one-semester course on queueing theory that does not require a course on stochastic processes as a prerequisite. By integrating the necessary background on stochastic processes with the analysis of models, the work provides a sound foundational introduction to the modeling and analysis of queueing systems for a broad interdisciplinary audience of students in mathematics, statistics, and applied disciplines such as computer science, operations research, and engineering. This edition includes additional topics in methodology and applications. Key features:

- An introductory chapter including a historical account of the growth of queueing theory in more than 100 years.
- A modeling-based approach with emphasis on identification of models
- Rigorous treatment of the foundations of basic models commonly used in applications with appropriate references for advanced topics.
- A chapter on matrix-analytic method as an alternative to the traditional methods of analysis of queueing systems.
- A comprehensive treatment of statistical inference for queueing systems.
- Modeling exercises and review exercises when appropriate.

The second edition of An Introduction of Queueing Theory may be used as a textbook by first-year graduate students in fields such as computer science, operations research, industrial and systems engineering, as well as related fields such as manufacturing and communications engineering. Upper-level undergraduate students in mathematics, statistics, and engineering may also use the book in an introductory course on queueing theory. With its rigorous coverage of basic material and extensive bibliography of the queueing literature, the work may also be useful to applied scientists and practitioners as a self-study reference for applications and further research. "...This book has brought a freshness and novelty as it deals mainly with modeling and analysis in applications as well as with statistical inference for queueing problems. With his 40 years of valuable experience in teaching and high level research in this subject area, Professor Bhat has been able to achieve what he aimed: to make [the work] somewhat different in content and approach from other books." - Assam Statistical Review of the first edition

Probability, Markov Chains, Queues, and Simulation The Mathematical Basis of Performance Modeling Princeton University Press

Presents the theory of general irreducible Markov chains and its connection to the Perron-Frobenius theory of nonnegative operators.

Markov processes are processes that have limited memory. In particular, their dependence on the past is only through the previous state. They are used to model the behavior of many systems including communications systems, transportation networks, image segmentation and analysis, biological systems and DNA sequence analysis, random atomic motion and diffusion in physics, social mobility, population studies, epidemiology, animal and insect migration, queueing systems, resource management, dams, financial engineering, actuarial science, and decision systems. Covering a wide range of areas of application of Markov processes, this second edition is revised to highlight the most important aspects as well as the most recent trends and applications of Markov processes. The author spent over 16 years in the industry before returning to academia, and he has applied many of the principles covered in this book in multiple research projects. Therefore, this is an applications-oriented book that also includes enough theory to provide a solid ground in the subject for the reader. Presents both the theory and applications of the different aspects of Markov processes Includes numerous solved examples as well as detailed diagrams that make it easier to understand the principle being presented Discusses different applications of hidden Markov models, such as DNA sequence analysis and speech analysis.

An Introduction to Stochastic Modeling provides information pertinent to the standard concepts and methods of stochastic modeling. This book presents the rich diversity of applications of stochastic processes in the sciences. Organized into nine chapters, this book begins with an overview of diverse types of stochastic models, which predicts a set of possible outcomes weighed by their likelihoods or probabilities. This text then provides exercises in the applications of simple stochastic analysis to appropriate problems. Other chapters consider the study of general functions of independent, identically distributed, nonnegative random variables representing the successive intervals between renewals. This book discusses as well the numerous examples of Markov branching processes that arise naturally in various scientific disciplines. The final chapter deals with queueing models, which aid the design process by predicting system performance. This book is a valuable resource for students of engineering and management science. Engineers will also find this book useful.

Intersecting two large research areas - numerical analysis and applied probability/queueing theory - this book is a self-contained introduction to the numerical solution of structured Markov chains, which have a wide applicability in queueing theory and stochastic modeling and include M/G/1 and GI/M/1-type Markov chain, quasi-birth-death processes, non-skip free queues and tree-like stochastic processes. Written for applied probabilists and numerical analysts, but accessible to engineers and scientists working on telecommunications and evaluation of computer systems performances, it provides a systematic treatment of the theory and algorithms for important families of structured Markov chains and a thorough overview of the current literature. The book, consisting

of nine Chapters, is presented in three parts. Part 1 covers a basic description of the fundamental concepts related to Markov chains, a systematic treatment of the structure matrix tools, including finite Toeplitz matrices, displacement operators, FFT, and the infinite block Toeplitz matrices, their relationship with matrix power series and the fundamental problems of solving matrix equations and computing canonical factorizations. Part 2 deals with the description and analysis of structure Markov chains and includes M/G/1, quasi-birth-death processes, non-skip-free queues and tree-like processes. Part 3 covers solution algorithms where new convergence and applicability results are proved. Each chapter ends with bibliographic notes for further reading, and the book ends with an appendix collecting the main general concepts and results used in the book, a list of the main annotations and algorithms used in the book, and an extensive index.

Critically acclaimed text for computer performance analysis--now in its second edition The Second Edition of this now-classic text provides a current and thorough treatment of queueing systems, queueing networks, continuous and discrete-time Markov chains, and simulation. Thoroughly updated with new content, as well as new problems and worked examples, the text offers readers both the theory and practical guidance needed to conduct performance and reliability evaluations of computer, communication, and manufacturing systems. Starting with basic probability theory, the text sets the foundation for the more complicated topics of queueing networks and Markov chains, using applications and examples to illustrate key points. Designed to engage the reader and build practical performance analysis skills, the text features a wealth of problems that mirror actual industry challenges. New features of the Second Edition include: * Chapter examining simulation methods and applications * Performance analysis applications for wireless, Internet, J2EE, and Kanban systems * Latest material on non-Markovian and fluid stochastic Petri nets, as well as solution techniques for Markov regenerative processes * Updated discussions of new and popular performance analysis tools, including ns-2 and OPNET * New and current real-world examples, including DiffServ routers in the Internet and cellular mobile networks With the rapidly growing complexity of computer and communication systems, the need for this text, which expertly mixes theory and practice, is tremendous. Graduate and advanced undergraduate students in computer science will find the extensive use of examples and problems to be vital in mastering both the basics and the fine points of the field, while industry professionals will find the text essential for developing systems that comply with industry standards and regulations.

This book provides an undergraduate-level introduction to discrete and continuous-time Markov chains and their applications, with a particular focus on the first step analysis technique and its applications to average hitting times and ruin probabilities. It also discusses classical topics such as recurrence and transience, stationary and limiting distributions, as well as branching processes. It first examines in detail two important examples (gambling processes and random walks) before presenting the general theory itself in the subsequent chapters. It also provides an introduction to discrete-time martingales and their relation to ruin probabilities and mean exit times, together with a chapter on spatial Poisson processes. The concepts presented are illustrated by examples, 138 exercises and 9 problems with their solutions.

A cornerstone of applied probability, Markov chains can be used to help model how plants grow, chemicals react, and atoms diffuse--and applications are increasingly being found in such areas as engineering, computer science, economics, and education. To apply the techniques to real problems, however, it is necessary to understand how Markov chains can be solved numerically. In this book, the first to offer a systematic and detailed treatment of the numerical solution of Markov chains, William Stewart provides scientists on many levels with the power to put this theory to use in the actual world, where it has applications in areas as diverse as engineering, economics, and education. His efforts make for essential reading in a rapidly growing field. Here Stewart explores all aspects of numerically computing solutions of Markov chains, especially when the state is huge. He provides extensive background to both discrete-time and continuous-time Markov chains and examines many different numerical computing methods--direct, single- and multi-vector iterative, and projection methods. More specifically, he considers recursive methods often used when the structure of the Markov chain is upper Hessenberg, iterative aggregation/disaggregation methods that are particularly appropriate when it is NCD (nearly completely decomposable), and reduced schemes for cases in which the chain is periodic. There are chapters on methods for computing transient solutions, on stochastic automata networks, and, finally, on currently available software. Throughout Stewart draws on numerous examples and comparisons among the methods he so thoroughly explains.

Primarily an introduction to the theory of stochastic processes at the undergraduate or beginning graduate level, the primary objective of this book is to initiate students in the art of stochastic modelling. However it is motivated by significant applications and progressively brings the student to the borders of contemporary research. Examples are from a wide range of domains, including operations research and electrical engineering. Researchers and students in these areas as well as in physics, biology and the social sciences will find this book of interest.

In this 2002 book, the author develops the necessary background in probability theory and Markov chains then discusses important computing applications.

Hidden Markov Models for Time Series: An Introduction Using R, Second Edition illustrates the great flexibility of hidden Markov models (HMMs) as general-purpose models for time series data. The book provides a broad understanding of the models and their uses. After presenting the basic model formulation, the book covers estimation, forecasting, decoding, prediction, model selection, and Bayesian inference for HMMs. Through examples and applications, the authors describe how to extend and generalize the basic model so that it can be applied in a rich variety of situations. The book demonstrates how HMMs can be applied to a wide range of types of time series: continuous-valued, circular, multivariate, binary, bounded and unbounded counts, and categorical observations. It also discusses how to employ the freely available computing environment R to carry out the computations.

Features Presents an accessible overview of HMMs Explores a variety of applications in ecology, finance, epidemiology, climatology, and sociology Includes numerous theoretical and programming exercises Provides most of the analysed data sets online New to the second edition A total of five chapters on extensions, including HMMs for longitudinal data, hidden semi-Markov models and models with continuous-valued state process New case studies on animal movement, rainfall occurrence and capture-recapture data

Queueing theory applications can be discovered in many walks of life including; transportation, manufacturing, telecommunications, computer systems and more. However, the most prevalent applications of queueing theory are in the telecommunications field. Queueing Theory for Telecommunications: Discrete Time Modelling of a Single Node System focuses on discrete time modeling and illustrates that most queueing systems encountered in real life can be set up as a Markov chain. This feature is very unique because the models are set in such a way that matrix-analytic methods are used to analyze them.

Queueing Theory for Telecommunications: Discrete Time Modelling of a Single Node System is the most relevant book available on queueing models designed for applications to telecommunications. This book presents clear concise theories behind how to model and analyze key single node queues in discrete time using special tools that were presented in the second chapter. The text also delves into the types of single node queues that are very frequently encountered in telecommunication systems modeling, and provides simple methods for analyzing them. Where appropriate, alternative analysis methods are also presented. This book is for advanced-level students and researchers concentrating on engineering, computer science and mathematics as a secondary text or reference book. Professionals who work in the related industries of telecommunications, industrial engineering and communications engineering will find this book useful as well.

Bridging the gap between research and application, Markov Chain Monte Carlo: Stochastic Simulation for Bayesian Inference provides a concise, and integrated account of Markov chain Monte Carlo (MCMC) for performing Bayesian inference. This volume, which was developed from a short course taught by the author at a meeting of Brazilian statisticians and probabilists, retains the didactic character of the original course text. The self-contained text units make MCMC accessible to scientists in other disciplines as well as statisticians. It describes each component of the theory in detail and outlines related software, which is of particular benefit to applied scientists.

The ultimate objective of this book is to present a panoramic view of the main stochastic processes which have an impact on applications, with complete proofs and exercises. Random processes play a central role in the applied sciences, including operations research, insurance, finance, biology, physics, computer and communications networks, and signal processing. In order to help the reader to reach a level of technical autonomy sufficient to understand the presented models, this book includes a reasonable dose of probability theory. On the other hand, the study of stochastic processes gives an opportunity to apply the main theoretical results of probability theory beyond classroom examples and in a non-trivial manner that makes this discipline look more attractive to the applications-oriented student. One can distinguish three parts of this book. The first four chapters are about probability theory, Chapters 5 to 8 concern random sequences, or discrete-time stochastic processes, and the rest of the book focuses on stochastic processes and point processes. There is sufficient modularity for the instructor or the self-teaching reader to design a course or a study program adapted to her/his specific needs. This book is in a large measure self-contained.

Communication networks underpin our modern world, and provide fascinating and challenging examples of large-scale stochastic systems. Randomness arises in communication systems at many levels: for example, the initiation and termination times of calls in a telephone network, or the statistical structure of the arrival streams of packets at routers in the Internet. How can routing, flow control and connection acceptance algorithms be designed to work well in uncertain and random environments? This compact introduction illustrates how stochastic models can be used to shed light on important issues in the design and control of communication networks. It will appeal to readers with a mathematical background wishing to understand this important area of application, and to those with an engineering background who want to grasp the underlying mathematical theory. Each chapter ends with exercises and suggestions for further reading.

Based on a popular course taught by the late Gian-Carlo Rota of MIT, with many new topics covered as well, Introduction to Probability with R presents R programs and animations to provide an intuitive yet rigorous understanding of how to model natural phenomena from a probabilistic point of view. Although the R programs are small in length, they are just as sophisticated and powerful as longer programs in other languages. This brevity makes it easy for students to become proficient in R. This calculus-based introduction organizes the material around key themes. One of the most important themes centers on viewing probability as a way to look at the world, helping students think and reason probabilistically. The text also shows how to combine and link stochastic processes to form more complex processes that are better models of natural phenomena. In addition, it presents a unified treatment of transforms, such as Laplace, Fourier, and z ; the foundations of fundamental stochastic processes using entropy and information; and an introduction to Markov chains from various viewpoints. Each chapter includes a short biographical note about a contributor to probability theory, exercises, and selected answers. The book has an accompanying website with more information.

"This book is a highly recommendable survey of mathematical tools and results in applied probability with special emphasis on queueing theory....The second edition at hand is a thoroughly updated and considerably expended version of the first edition.... This book and the way the various topics are balanced are a welcome addition to the literature. It is an indispensable source of information for both advanced graduate students and researchers." --MATHEMATICAL REVIEWS

Presents the basic mathematical ideas and algorithms of the matrix analytic theory in a readable, up-to-date, and comprehensive manner.

Building upon the previous editions, this textbook is a first course in stochastic processes taken by undergraduate and graduate students (MS and PhD students from math, statistics, economics, computer science, engineering, and finance departments) who have had a course in probability theory. It covers Markov chains in discrete and continuous time, Poisson processes, renewal processes, martingales, and option pricing. One can only learn a subject by seeing it in action, so there are a large number of examples and more than 300 carefully chosen exercises to deepen the reader's understanding. Drawing from teaching experience and student feedback, there are many new examples and problems with solutions that use TI-83 to eliminate the tedious details of solving linear equations by hand, and the collection of exercises is much improved, with many more biological examples. Originally included in previous editions, material too advanced for this first course in stochastic processes has been eliminated while treatment of other topics useful for applications has been expanded. In addition, the ordering of topics has been improved; for example, the difficult subject of martingales is delayed until its usefulness can be applied in the treatment of mathematical finance.

An accessible introduction to probability, stochastic processes, and statistics for computer science and engineering applications. Second edition now also available in Paperback. This updated and revised edition of the popular classic first edition relates fundamental concepts in probability and statistics to the computer sciences and engineering. The author uses Markov chains and other statistical tools to illustrate processes in reliability of computer systems and networks, fault tolerance, and performance. This edition features an entirely new section on stochastic Petri nets—as well as new sections on system availability modeling, wireless system modeling, numerical solution techniques for Markov chains, and software reliability modeling, among other subjects. Extensive revisions take new developments in solution techniques and applications into account and bring this work totally up to date. It includes more than 200 worked examples and self-study exercises for each section. Probability and Statistics with

Reliability, Queuing and Computer Science Applications, Second Edition offers a comprehensive introduction to probability, stochastic processes, and statistics for students of computer science, electrical and computer engineering, and applied mathematics. Its wealth of practical examples and up-to-date information makes it an excellent resource for practitioners as well. An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department. Stochastic processes are mathematical models of random phenomena that evolve according to prescribed dynamics. Processes commonly used in applications are Markov chains in discrete and continuous time, renewal and regenerative processes, Poisson processes, and Brownian motion. This volume gives an in-depth description of the structure and basic properties of these stochastic processes. A main focus is on equilibrium distributions, strong laws of large numbers, and ordinary and functional central limit theorems for cost and performance parameters. Although these results differ for various processes, they have a common trait of being limit theorems for processes with regenerative increments. Extensive examples and exercises show how to formulate stochastic models of systems as functions of a system's data and dynamics, and how to represent and analyze cost and performance measures. Topics include stochastic networks, spatial and space-time Poisson processes, queueing, reversible processes, simulation, Brownian approximations, and varied Markovian models. The technical level of the volume is between that of introductory texts that focus on highlights of applied stochastic processes, and advanced texts that focus on theoretical aspects of processes.

Markov chains are central to the understanding of random processes. This is not only because they pervade the applications of random processes, but also because one can calculate explicitly many quantities of interest. This textbook, aimed at advanced undergraduate or MSc students with some background in basic probability theory, focuses on Markov chains and quickly develops a coherent and rigorous theory whilst showing also how actually to apply it. Both discrete-time and continuous-time chains are studied. A distinguishing feature is an introduction to more advanced topics such as martingales and potentials in the established context of Markov chains. There are applications to simulation, economics, optimal control, genetics, queues and many other topics, and exercises and examples drawn both from theory and practice. It will therefore be an ideal text either for elementary courses on random processes or those that are more oriented towards applications.

The purpose of this book is to provide a sound introduction to the study of real-world phenomena that possess random variation. It describes how to set up and analyse models of real-life phenomena that involve elements of chance. Motivation comes from everyday experiences of probability, such as that of a dice or cards, the idea of fairness in games of chance, and the random ways in which, say, birthdays are shared or particular events arise. Applications include branching processes, random walks, Markov chains, queues, renewal theory, and Brownian motion. This textbook contains many worked examples and several chapters have been updated and expanded for the second edition. Some mathematical knowledge is assumed. The reader should have the ability to work with unions, intersections and complements of sets; a good facility with calculus, including integration, sequences and series; and appreciation of the logical development of an argument. Probability Models is designed to aid students studying probability as part of an undergraduate course on mathematics or mathematics and statistics.

Topics include matrix-geometric invariant vectors, buffer models, queues in a random environment and more.

Written with computer scientists and engineers in mind, this book brings queueing theory decisively back to computer science.

"This well-written book provides a clear and accessible treatment of the theory of discrete and continuous-time Markov chains, with an emphasis towards applications. The mathematical treatment is precise and rigorous without superfluous details, and the results are immediately illustrated in illuminating examples. This book will be extremely useful to anybody teaching a course on Markov processes." Jean-François Le Gall, Professor at Université de Paris-Orsay, France. Markov processes is the class of stochastic processes whose past and future are conditionally independent, given their present state. They constitute important models in many applied fields. After an introduction to the Monte Carlo method, this book describes discrete time Markov chains, the Poisson process and continuous time Markov chains. It also presents numerous applications including Markov Chain Monte Carlo, Simulated Annealing, Hidden Markov Models, Annotation and Alignment of Genomic sequences, Control and Filtering, Phylogenetic tree reconstruction and Queuing networks. The last chapter is an introduction to stochastic calculus and mathematical finance. Features include: The Monte Carlo method, discrete time Markov chains, the Poisson process and continuous time jump Markov processes. An introduction to diffusion processes, mathematical finance and stochastic calculus. Applications of Markov processes to various fields, ranging from mathematical biology, to financial engineering and computer science. Numerous exercises and problems with solutions to most of them

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.

Probability, Markov Chains, Queues, and Simulation provides a modern and authoritative treatment of the mathematical processes that underlie performance modeling. The detailed explanations of mathematical derivations and numerous illustrative examples make this textbook readily accessible to graduate and advanced undergraduate students taking courses in which stochastic processes play a fundamental role. The textbook is relevant to a wide variety of fields, including computer science, engineering, operations research, statistics, and mathematics. The textbook looks at the fundamentals of probability theory, from the basic concepts of set-based probability, through probability distributions, to bounds, limit theorems, and the laws of large numbers. Discrete and continuous-time Markov chains are analyzed from a theoretical and computational point of view. Topics include the Chapman-Kolmogorov equations; irreducibility; the potential, fundamental, and reachability matrices; random walk problems; reversibility; renewal processes; and the

numerical computation of stationary and transient distributions. The M/M/1 queue and its extensions to more general birth-death processes are analyzed in detail, as are queues with phase-type arrival and service processes. The M/G/1 and G/M/1 queues are solved using embedded Markov chains; the busy period, residual service time, and priority scheduling are treated. Open and closed queueing networks are analyzed. The final part of the book addresses the mathematical basis of simulation. Each chapter of the textbook concludes with an extensive set of exercises. An instructor's solution manual, in which all exercises are completely worked out, is also available (to professors only). Numerous examples illuminate the mathematical theories Carefully detailed explanations of mathematical derivations guarantee a valuable pedagogical approach Each chapter concludes with an extensive set of exercises

Papers presented at a workshop held January 1990 (location unspecified) cover just about all aspects of solving Markov models numerically. There are papers on matrix generation techniques and generalized stochastic Petri nets; the computation of stationary distributions, including aggregation/disagg

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A path-breaking account of Markov decision processes-theory and computation This book's clear presentation of theory, numerous chapter-end problems, and development of a unified method for the computation of optimal policies in both discrete and continuous time make it an excellent course text for graduate students and advanced undergraduates. Its comprehensive coverage of important recent advances in stochastic dynamic programming makes it a valuable working resource for operations research professionals, management scientists, engineers, and others. Stochastic Dynamic Programming and the Control of Queueing Systems presents the theory of optimization under the finite horizon, infinite horizon discounted, and average cost criteria. It then shows how optimal rules of operation (policies) for each criterion may be numerically determined. A great wealth of examples from the application area of the control of queueing systems is presented. Nine numerical programs for the computation of optimal policies are fully explicated. The Pascal source code for the programs is available for viewing and downloading on the Wiley Web site at www.wiley.com/products/subject/mathematics. The site contains a link to the author's own Web site and is also a place where readers may discuss developments on the programs or other aspects of the material. The source files are also available via ftp at ftp://ftp.wiley.com/public/sci_tech_med/stochastic Stochastic Dynamic Programming and the Control of Queueing Systems features: * Path-breaking advances in Markov decision process techniques, brought together for the first time in book form * A theorem/proof format (proofs may be omitted without loss of continuity) * Development of a unified method for the computation of optimal rules of system operation * Numerous examples drawn mainly from the control of queueing systems * Detailed discussions of nine numerical programs * Helpful chapter-end problems * Appendices with complete treatment of background material

Queueing analysis is a vital tool used in the evaluation of system performance. Applications of queueing analysis cover a wide spectrum from bank automated teller machines to transportation and communications data networks. Fully revised, this second edition of a popular book contains the significant addition of a new chapter on Flow & Congestion Control and a section on Network Calculus among other new sections that have been added to remaining chapters. An introductory text, Queueing Modelling Fundamentals focuses on queueing modelling techniques and applications of data networks, examining the underlying principles of isolated queueing systems. This book introduces the complex queueing theory in simple language/proofs to enable the reader to quickly pick up an overview to queueing theory without utilizing the diverse necessary mathematical tools. It incorporates a rich set of worked examples on its applications to communication networks. Features include: Fully revised and updated edition with significant new chapter on Flow and Congestion Control as-well-as a new section on Network Calculus A comprehensive text which highlights both the theoretical models and their applications through a rich set of worked examples, examples of applications to data networks and performance curves Provides an insight into the underlying queuing principles and features step-by-step derivation of queueing results Written by experienced Professors in the field Queueing Modelling Fundamentals is an introductory text for undergraduate or entry-level post-graduate students who are taking courses on network performance analysis as well as those practicing network administrators who want to understand the essentials of network operations. The detailed step-by-step derivation of queueing results also makes it an excellent text for professional engineers.

Introduction to Probability Models, Tenth Edition, provides an introduction to elementary probability theory and stochastic processes. There are two approaches to the study of probability theory. One is heuristic and nonrigorous, and attempts to develop in students an intuitive feel for the subject that enables him or her to think probabilistically. The other approach attempts a rigorous development of probability by using the tools of measure theory. The first approach is employed in this text. The book begins by introducing basic concepts of probability theory, such as the random variable, conditional probability, and conditional expectation. This is followed by discussions of stochastic processes, including Markov chains and Poisson processes. The remaining chapters cover queueing, reliability theory, Brownian motion, and simulation. Many examples are worked out throughout the text, along with exercises to be solved by students. This book will be particularly useful to those interested in learning how probability theory can be applied to the study of phenomena in fields such as engineering, computer science, management science, the physical and social sciences, and operations research. Ideally, this text would be used in a one-year course in probability models, or a one-semester course in introductory probability theory or a course in elementary stochastic processes. New to this Edition: 65% new chapter material including coverage of finite capacity queues, insurance risk models and Markov chains Contains compulsory material for new Exam 3 of the Society of Actuaries containing several sections in the new exams Updated data, and a list of commonly used notations and equations, a robust ancillary package, including a ISM, SSM, and test bank Includes SPSS PASW Modeler and SAS JMP software packages which are widely used in the field Hallmark features: Superior writing style Excellent exercises and examples covering the wide breadth of coverage of probability topics Real-world applications in engineering, science, business and

economics

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