Chapter 1 : Staff View: Modeling and analysis of stochastic systems /

"The third edition of Modeling and Analysis of Stochastic Systems remains an excellent book for a graduate-level study of stochastic processes. The aim of the book is modeling with stochastic elements in practical settings and analysis of the resulting stochastic model.

 Stochastic optimal control and filtering theory have been at the forefront of modern control theory and communication engineering. Filtering theory has played a significant role in space explorations, navigation, aerospace, radar, satellite and meteorological applications. In recent years, stochastic control theory has been playing an important role in the study of biomathematics and mathematical finance, as well as adaptive and network controlled systems, which is a vital research field in modern control theory. This is primarily because of the fact that deterministic systems are to a large extent an abstraction, and all practical systems do have a certain degree of random and uncertain behavior in the form of noise, disturbance, and random failures. Moreover, due to this element of randomness, stochastic systems are more complicated than deterministic systems. Therefore, a satisfactory resolution of many new, challenging, and complicated problems arising in the above areas, other engineering fields and scientific phenomenon, and involving modeling, identification, estimation, analysis and synthesis, require more advanced tools and rigorous investigations than hitherto available. This special issue aims to introduce new developments in the theory of stochastic control systems with applications to engineering fields such as communication, networked control, system reliability, and mathematical finance. However, the main focus of the special issue is on stochastic modeling, analysis, and control, with particular emphasis on stability and stabilization, adaptive control, robust optimal control and filtering. Close to 50 papers were received, but only 30 could be accepted after a rigorous peer review to guarantee the highest quality of the special issue. A quick summary of the final accepted papers and therefore the contents of the special issue is as follows. There are four papers concerning nonlinear stochastic adaptive control listed as follows: The second set of three papers deal with the application of stochastic control theory to mathematical finance and are listed as follows: The third set of papers are concerned with stochastic robust optimal control and filtering, and there are five papers in this category listed as follows: Then come the fifth set of four papers dealing entirely with networked control and communication. These are listed as follows: In addition, there are two papers that are devoted to queuing systems and one paper to systems reliability. The remaining set of papers deal with diverse topics and subjects, ranging from mobile robots to neural networks and from traffic control to navigation. We quickly recall their various titles here. Acknowledgments As the Lead Guest Editor of this special issue, I wish to express my profound gratitude to my three coeditors for accepting to undertake this project with me and the wonderful accomplishment that we have been able to achieve. I hope that the excellent work that has been assembled in this special issue will go a long way in stimulating further research in this important and active research area, as well as answering a lot of questions that were hitherto unanswered. We are also deeply appreciative of the efforts of the authors in submitting to the special issue regardless of the outcome of the review process. Finally, we also want to thank all the referees who have helped us in ensuring the highest quality of papers to be included in the special issue, and without whose help nothing would have been accomplished. The cooperation of the Editor-in-Chief of Mathematical Problems in Engineering and the staff of Hindawi Publishing Corporation is hereby also graciously acknowledged.

Chapter 2 : Stochastic Systems

Summary. Building on the author's more than 35 years of teaching experience, Modeling and Analysis of Stochastic Systems, Third Edition, covers the most important classes of stochastic processes used in the modeling of diverse systems.

Stochastic systems are at the core of a number of disciplines in engineering, for example communication systems and machine learning. They also find application elsewhere, including social systems, markets, molecular biology and epidemiology. Ranking of nodes in networks. The idea is to associate importance of a node with its degree of connectivity. A link by node 4 is more important than a link from node 1. We will study the algorithm used by Google to solve this ranking problem. The goal of the class is to learn how to model, analyze and simulate stochastic systems. With respect to analysis we distinguish between what we could call theoretical and experimental analysis. By theoretical analysis we refer to a set of tools which let us discover and understand properties of the system. These analyses can only take us so far and is usually complemented with numerical analysis of experimental outcomes. Although we use the word experiment more often than not we simulate the stochastic system in a computer and analyze the outcomes of these virtual experiments. To get a better feel of what this class is about you might want to check the slides for the first two lectures that study a simple stochastic system. This example considers a certain game in a certain casino where your chances of winning are slightly better than your chances of loosing. The catch is that you have to keep playing forever or until you loose all your money. You have to balance the fact that while you are more likely to win than loose, there is always a chance of getting unlucky a few times and losing all your money. And since you have to keep playing forever the latter possibility cannot be ignored heedlessly. To try things on your own here is the Matlab code to simulate one experiment. This other code repeats the experiment a hundred times and the numerical analysis of outcomes is undertaken here. The remaining of this page contains information about the following Class Contents. Summary description of topics covered. Applications of stochastic processes that will be studied in class. Textbook and other materials. Prerequisites, grading and office hours. Class contents The class is roughly divided in four blocks. The first block is a quick review of probability. As part of this block we study some commonly used probability distributions including normal, uniform, binomial and exponential. We will also talk about the definition of limits in probability theory. This will consume six lectures. Since reactions occur at random and the number of molecules involved is small, stochastic models are needed to understand the lac operon and biochemical reactions in general. Not to get too technical about it, a stochastic process is a function that assigns a function to a random event compare this with the definition of a random variable as a function that assigns a value to a random event. These are complicated entities, and we usually restrict our attention to cases that have a more tractable description. In the second block of the class we encounter such first tractable class: The block on MCs will close with a description of the algorithm used by Google to rank web pages. We will use nine lectures for this block. You can download slides for the lectures and Matlab code for examples covered in class. Albeit more mathematically challenging, CTMCs are very common in practice. In rough terms, we can say that any system that can be deterministically modeled with a differential equation can be stochastically modeled as a CTMC. We will close this block with two examples: We will devote twelve lectures to this topic. The natural progression of the class is to eliminate the restriction on the countable number of states and the memoryless property. This will be covered in the fourth block of the class on general stationary random processes SSP. Simple examples of SSPs, including Brownian motion, geometric Brownian motion and white noise will be introduced. The most important tools in the analysis of SSP are the autocorrelation function and the power spectral density, the latter of which is a generalization of the Fourier transform to random settings. Nine lectures will be used for these digressions. In the last 30 years or so we have come to realize that randomness is a fundamental property of systems. A look at this picture suffices to convince oneself that randomness plays a role in the price of stocks. Empirically, it has been observed that stock prices can be modeled as a geometric Brownian motion. This observation is the basis for the pricing of options and derivatives in general. The first application concerns the problem of ranking elements of a network that arises in social sciences as well as in computer science. However, it is not only a matter of counting the number of links to a node, but also of pondering the importance of the nodes that point to it, see Fig. An elegant solution to this problem is a stochastic algorithm based on a random walk through elements of the network. This algorithm will be covered in class and in Homework 6. We will also consider simulation and modeling of biochemical reactions that are characterized by the involvement of a small number of reactants. In such cases it is known that randomness may play an important role in the overall behavior of the system. In Homework 10 you will use this algorithm to study the gene autoregulatory network that controls the digestion of lactose; see Fig. A third set of examples is queueing systems. These systems comprise arrival of customers and their service. In between their arrival and their service customers stay in a queue. We purport to answer questions on how much time customers stay in the queue, and how many customers are expected to be waiting for service. This model is pervasive in communications where "customers" represent information packets to be transmitted. A look at Fig. This fact and the concept of arbitrage, that is, the opportunity to realize a benefit without risk, permit introduction of the risk neutral measure. Black-Scholes formula for option pricing, as well as the pricing of derivatives in general, is a simple application of the risk neutral measure. There are many other examples that could be studied, and we are indeed, considering many more in the homework assignments. You are invited to take a look.

Chapter 3 : Modeling and Analysis of Stochastic Systems: 3rd Edition (Hardback) - Routledge

This is an introductory-level text on stochastic modeling. It is suited for undergraduate students in engineering, operations research, statistics, mathematics, actuarial science, business management, computer science, and public policy.

Marginal Distribution Transient Behavior: Occupancy Times Computation of P t: Finite State-Space Computation of P t: Probability of Events Appendix B: Univariate Random Variables Appendix C: Multivariate Random Variables Appendix D: Generating Functions Appendix E: Laplace-Stieltjes Transforms Appendix F: Laplace Transforms Appendix G: Modes of Convergence Appendix H: Results from Analysis Appendix I: The modelling examples include many that would be of interest for advanced undergraduate courses on inventory management, reliability, operations management and queuing networks. This is a book for the few who would like to know almost everything about stochastic processes and for the many who need to know something, and would like to have their eyes opened to the many models and analytical results available on stochastic processes. The material is carefully chosen and presented in a systematic way, starting with the basics and reaching more advanced topics. It is very useful to see a large number of examples worked out in detail. Thus, besides university courses, the book can be successfully used for self-education. This book is a good example of how to write on sophisticated topics about stochastic processes without involving the heavy measure theoretic machinery. Another advantage of the book is the application-oriented approach that is followed by the author. This book can be strongly recommended for introductory, intermediate or advanced university courses on stochastic processes. Both students and their teachers may benefit considerably from it. Series A, July The publishers are also to be commended on its nice production: In all, it is an excellent textbook for use in introductory courses on stochastic processes. Plenty of applications, examples, and exercises bring the reader to the intuitive understanding of the subject.

Chapter 4 : Modeling and Analysis of Stochastic Systems - CRC Press Book

Reviewer: Robert B. Cooper According to the preface, this textbook is designed for a two-semester graduate course in stochastic models for students of operations research, computer science, business and public policy analysis, and engineering.

Chapter 5 : Stochastic systems analysis and simulation | Main / Stochastic Systems Analysis and Simulatio

This is an introductory-level text on stochastic modeling. It is suited for undergraduate students in engineering, operations research, statistics, mathematics, actuarial science, business.

Chapter 6 : Modeling and Analysis of Stochastic Systems - Vidyadhar G. Kulkarni - Google Books

This is an introductory-level text on stochastic modeling. It is suited for undergraduate students in engineering, operations research, statistics, mathematics, actuarial science, business management, computer science, and public policy. It employs a large number of examples to teach the students to.

Chapter 7 : Control and Analysis of Stochastic Systems â€“ Certain Analysis for Uncertain Systems

The major classes of useful stochastic processes - discrete and continuous time Markov chains, renewal processes, regenerative processes, and Markov regenerative processes - are presented, with an emphasis on modelling real-life situations with stochastic elements and analyzing the resulting stochastic model.

Chapter 8 : Stochastic process - Wikipedia

Preface This manual contains solutions to the problems in Stochastic Modeling: Analysis and Simu- lation that do not require computer simulation. For obvious reasons, simulation results de-.

Chapter 9 : Modeling And Analysis Of Stochastic Systems by Vidyadhar G. Kulkarni

Corrections to the Second Edition of Modeling and Analysis of Stochastic Systems Vidyadhar Kulkarni November 11, Send additional corrections to the author at his email address vkulkarn@blog.quintoapp.com