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Stochastic Optimal Control of Structures



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Stochastic Processes And Optimal Control

**Wendell H. Fleming, Raymond W.
Rishel**



Stochastic Processes And Optimal Control:

Deterministic and Stochastic Optimal Control Wendell H. Fleming, Raymond W. Rishel, 2012-12-06 This book may be regarded as consisting of two parts In Chapters I-IV we present what we regard as essential topics in an introduction to deterministic optimal control theory This material has been used by the authors for one semester graduate level courses at Brown University and the University of Kentucky The simplest problem in calculus of variations is taken as the point of departure in Chapter I Chapters II-III and IV deal with necessary conditions for an optimum existence and regularity theorems for optimal controls and the method of dynamic programming The beginning reader may find it useful first to learn the main results corollaries and examples These tend to be found in the earlier parts of each chapter We have deliberately postponed some difficult technical proofs to later parts of these chapters In the second part of the book we give an introduction to stochastic optimal control for Markov diffusion processes Our treatment follows the dynamic programming method and depends on the intimate relationship between second order partial differential equations of parabolic type and stochastic differential equations This relationship is reviewed in Chapter V which may be read independently of Chapters I-IV Chapter VI is based to a considerable extent on the authors work in stochastic control since 1961 It also includes two other topics important for applications namely the solution to the stochastic linear regulator and the separation principle

Stochastic Processes and Optimal Control Hans Jürgen Engelbert, Ioanis Karatzas, Michael Röckner, 1993 Focusing on the most interesting problems currently facing stochastic processes researchers The winter school organized two series of lectures Constrained Control Problems in Finance Mathematics given by Ioanis Karatzas and Dirichlet Forms and Stochastic Processes presented by Michael Rockner Other papers in this collection detail recent developments in stochastic processes stochastic analysis Markov processes and optimal stochastic control

Introduction to Stochastic Control Theory Karl J. Åström, 2006-01-06 Unabridged republication of the edition published by Academic Press 1970

Stochastic Controls Jiongmin Yong, Xun Yu Zhou, 2012-12-06 As is well known Pontryagin's maximum principle and Bellman's dynamic programming are the two principal and most commonly used approaches in solving stochastic optimal control problems An interesting phenomenon one can observe from the literature is that these two approaches have been developed separately and independently Since both methods are used to investigate the same problems a natural question one will ask is the following Q What is the relationship between the maximum principle and dynamic programming in stochastic optimal controls There did exist some researches prior to the 1980s on the relationship between these two Nevertheless the results usually were stated in heuristic terms and proved under rather restrictive assumptions which were not satisfied in most cases In the statement of a Pontryagin type maximum principle there is an adjoint equation which is an ordinary differential equation ODE in the finite dimensional deterministic case and a stochastic differential equation SDE in the stochastic case The system consisting of the adjoint equation the original state equation and the maximum condition is referred to as an extended

Hamiltonian system On the other hand in Bellman's dynamic programming there is a partial differential equation PDE of first order in the finite dimensional deterministic case and of second order in the stochastic case This is known as a Hamilton-Jacobi-Bellman HJB equation Methods of Optimal Statistical Decisions, Optimal Control, and Stochastic Differential Equations Ellida M. Khazen, 2009-11-16 This book provides the reader with some insight into the mathematical models of random processes with continuous time stochastic differential equations and stochastic integrals An advanced development of the mathematical methods of optimal statistical decisions statistical sequential analysis and informational estimation of risks and new methods and solutions to the important problems of the theory of optimal control are presented The new original results obtained by this author and published shortly in her numerous scientific research papers are presented in a systematic way in this book The book is intended for engineers students post graduate students and scientist researchers The presentation of the material is accessible to engineers *Optimal Control of Diffusion Processes* Vivek S. Borkar, 1989

Controlled Stochastic Processes I. I. Gihman, A. V. Skorohod, 2012-12-06 The theory of controlled processes is one of the most recent mathematical theories to show very important applications in modern engineering particularly for constructing automatic control systems as well as for problems of economic control However actual systems subject to control do not admit a strictly deterministic analysis in view of random factors of various kinds which influence their behavior Such factors include for example random noise occurring in the electrical system variations in the supply and demand of commodities fluctuations in the labor force in economics and random failures of components on an automated line The theory of controlled processes takes the random nature of the behavior of a system into account In such cases it is natural when choosing a control strategy to proceed from the average expected result taking note of all the possible variants of the behavior of a controlled system An extensive literature is devoted to various economic and engineering systems of control some of these works are listed in the Bibliography is no text which adequately covers the general However as of now there mathematical theory of controlled processes The authors of this monograph have attempted to fill this gap In this volume the general theory of discrete parameter time controlled processes Chapter 1 and those with continuous time Chapter 2 as well as the theory of controlled stochastic differential equations Chapter 3 are presented **Stochastic Control in Insurance** Hanspeter Schmidli, 2007-11-20 Stochastic control is one of the methods being used to find optimal decision making strategies in fields such as operations research and mathematical finance This book provides a systematic treatment of optimal control methods applied to problems from insurance and investment complete with detailed proofs The theory is discussed and illustrated by way of examples using concrete simple optimisation problems that occur in the actuarial sciences The problems come from non life insurance as well as life and pension insurance and also cover the famous Merton problem from mathematical finance The book is directed towards graduate students and researchers in actuarial science and mathematical finance who want to learn stochastic control within an insurance setting but it will also appeal to applied

probabilists interested in the insurance applications and to practitioners who want to learn more about how the method works

An Introduction to Optimal Control Theory Onésimo Hernández-Lerma, Leonardo R. Laura-Guarachi, Saul Mendoza-Palacios, David González-Sánchez, 2023-02-21 This book introduces optimal control problems for large families of deterministic and stochastic systems with discrete or continuous time parameter These families include most of the systems studied in many disciplines including Economics Engineering Operations Research and Management Science among many others The main objective is to give a concise systematic and reasonably self contained presentation of some key topics in optimal control theory To this end most of the analyses are based on the dynamic programming DP technique This technique is applicable to almost all control problems that appear in theory and applications They include for instance finite and infinite horizon control problems in which the underlying dynamic system follows either a deterministic or stochastic difference or differential equation In the infinite horizon case it also uses DP to study undiscounted problems such as the ergodic or long run average cost After a general introduction to control problems the book covers the topic dividing into four parts with different dynamical systems control of discrete time deterministic systems discrete time stochastic systems ordinary differential equations and finally a general continuous time MCP with applications for stochastic differential equations The first and second part should be accessible to undergraduate students with some knowledge of elementary calculus linear algebra and some concepts from probability theory random variables expectations and so forth Whereas the third and fourth part would be appropriate for advanced undergraduates or graduate students who have a working knowledge of mathematical analysis derivatives integrals and stochastic processes

Stochastic Optimal Transportation Toshio Mikami, 2021-06-15 In this book the optimal transportation problem OT is described as a variational problem for absolutely continuous stochastic processes with fixed initial and terminal distributions Also described is Schrödinger's problem which is originally a variational problem for one step random walks with fixed initial and terminal distributions The stochastic optimal transportation problem SOT is then introduced as a generalization of the OT i.e. as a variational problem for semimartingales with fixed initial and terminal distributions An interpretation of the SOT is also stated as a generalization of Schrödinger's problem After the brief introduction above the fundamental results on the SOT are described duality theorem a sufficient condition for the problem to be finite forward backward stochastic differential equations SDE for the minimizer and so on The recent development of the superposition principle plays a crucial role in the SOT A systematic method is introduced to consider two problems one with fixed initial and terminal distributions and one with fixed marginal distributions for all times By the zero noise limit of the SOT the probabilistic proofs to Monge's problem with a quadratic cost and the duality theorem for the OT are described Also described are the Lipschitz continuity and the semiconcavity of Schrödinger's problem in marginal distributions and random variables with given marginals respectively As well there is an explanation of the regularity result for the solution to Schrödinger's functional equation when the space of Borel probability measures is

endowed with a strong or a weak topology and it is shown that Schrödinger's problem can be considered a class of mean field games. The construction of stochastic processes with given marginals called the marginal problem for stochastic processes is discussed as an application of the SOT and the OT.

Modern Trends in Controlled Stochastic Processes Alexey B. Piunovskiy, 2010-09. World leading experts give their accounts of the modern mathematical models in the field: Markov Decision Processes, controlled diffusions, piecewise deterministic processes etc. with a wide range of performance functionals. One of the aims is to give a general view on the state of the art. The authors use Dynamic Programming, Convex Analytic Approach, several numerical methods, index based approach and so on. Most chapters either contain well developed examples or are entirely devoted to the application of the mathematical control theory to real life problems from such fields as Insurance, Portfolio Optimization and Information Transmission. The book will enable researchers, academics and research students to get a sense of novel results, concepts, models, methods and applications of controlled stochastic processes. *The*

Optimal Control of Discrete Stochastic Processes A. Alan B. Pritsker, 1961. [Continuous-time Stochastic Control and Optimization with Financial Applications](#) Huyên Pham, 2009-05-28. Stochastic optimization problems arise in decision making problems under uncertainty and find various applications in economics and finance. On the other hand, problems in finance have recently led to new developments in the theory of stochastic control. This volume provides a systematic treatment of stochastic optimization problems applied to finance by presenting the different existing methods: dynamic programming, viscosity solutions, backward stochastic differential equations and martingale duality methods. The theory is discussed in the context of recent developments in this field with complete and detailed proofs and is illustrated by means of concrete examples from the world of finance: portfolio allocation, option hedging, real options, optimal investment etc. This book is directed towards graduate students and researchers in mathematical finance and will also benefit applied mathematicians interested in financial applications and practitioners wishing to know more about the use of stochastic optimization methods in finance.

Modern Trends in Controlled Stochastic Processes: Alexey Piunovskiy, Yi Zhang, 2021-06-05. This book presents state of the art solution methods and applications of stochastic optimal control. It is a collection of extended papers discussed at the traditional Liverpool workshop on controlled stochastic processes with participants from both the east and the west. New problems are formulated and progresses of ongoing research are reported. Topics covered in this book include theoretical results and numerical methods for Markov and semi Markov decision processes, optimal stopping of Markov processes, stochastic games, problems with partial information, optimal filtering, robust control, Q learning and self organizing algorithms. Real life case studies and applications e.g. queueing systems, forest management, control of water resources, marketing science and healthcare are presented. Scientific researchers and postgraduate students interested in stochastic optimal control as well as practitioners will find this book appealing and a valuable reference.

Stochastic Control Theory Makiko Nisio, 2014-11-27. This book offers a systematic introduction to the optimal stochastic control theory via the

dynamic programming principle which is a powerful tool to analyze control problems First we consider completely observable control problems with finite horizons Using a time discretization we construct a nonlinear semigroup related to the dynamic programming principle DPP whose generator provides the Hamilton Jacobi Bellman HJB equation and we characterize the value function via the nonlinear semigroup besides the viscosity solution theory When we control not only the dynamics of a system but also the terminal time of its evolution control stopping problems arise This problem is treated in the same frameworks via the nonlinear semigroup Its results are applicable to the American option price problem Zero sum two player time homogeneous stochastic differential games and viscosity solutions of the Isaacs equations arising from such games are studied via a nonlinear semigroup related to DPP the min max principle to be precise Using semi discretization arguments we construct the nonlinear semigroups whose generators provide lower and upper Isaacs equations Concerning partially observable control problems we refer to stochastic parabolic equations driven by colored Wiener noises in particular the Zakai equation The existence and uniqueness of solutions and regularities as well as It s formula are stated A control problem for the Zakai equations has a nonlinear semigroup whose generator provides the HJB equation on a Banach space The value function turns out to be a unique viscosity solution for the HJB equation under mild conditions This edition provides a more generalized treatment of the topic than does the earlier book Lectures on Stochastic Control Theory ISI Lecture Notes 9 where time homogeneous cases are dealt with Here for finite time horizon control problems DPP was formulated as a one parameter nonlinear semigroup whose generator provides the HJB equation by using a time discretization method The semigroup corresponds to the value function and is characterized as the envelope of Markovian transition semigroups of responses for constant control processes Besides finite time horizon controls the book discusses control stopping problems in the same frameworks

Controlled Diffusion Processes N. V. Krylov, 2009-08-29 Stochastic control theory is a relatively young branch of mathematics The beginning of its intensive development falls in the late 1950s and early 1960s during that period an extensive literature appeared on optimal stochastic control using the quadratic performance criterion see references in Wonham 76 At the same time Girsanov 25 and Howard 26 made the first steps in constructing a general theory based on Bellman s technique of dynamic programming developed by him somewhat earlier 4 Two types of engineering problems engendered two different parts of stochastic control theory Problems of the first type are associated with multistep decision making in discrete time and are treated in the theory of discrete stochastic dynamic programming For more on this theory we note in addition to the work of Howard and Bellman mentioned above the books by Derman 8 Mine and Osaki 55 and Dynkin and Yushkevich 12 Another class of engineering problems which encouraged the development of the theory of stochastic control involves time continuous control of a dynamic system in the presence of random noise The case where the system is described by a differential equation and the noise is modeled as a time continuous random process is the core of the optimal control theory of diffusion processes This book deals with this latter theory

Linear Stochastic Control

Systems Goong Chen, Guanrong Chen, Shih-Hsun Hsu, 1995-07-12 Linear Stochastic Control Systems presents a thorough description of the mathematical theory and fundamental principles of linear stochastic control systems Both continuous time and discrete time systems are thoroughly covered Reviews of the modern probability and random processes theories and the It stochastic differential equations are provided Discrete time stochastic systems theory optimal estimation and Kalman filtering and optimal stochastic control theory are studied in detail A modern treatment of these same topics for continuous time stochastic control systems is included The text is written in an easy to understand style and the reader needs only to have a background of elementary real analysis and linear deterministic systems theory to comprehend the subject matter This graduate textbook is also suitable for self study professional training and as a handy research reference Linear Stochastic Control Systems is self contained and provides a step by step development of the theory with many illustrative examples exercises and engineering applications

Stochastic Optimal Control in Infinite Dimension Giorgio Fabbri, Fausto Gozzi, Andrzej Święch, 2017-06-22 Providing an introduction to stochastic optimal control in infinite dimension this book gives a complete account of the theory of second order HJB equations in infinite dimensional Hilbert spaces focusing on its applicability to associated stochastic optimal control problems It features a general introduction to optimal stochastic control including basic results e g the dynamic programming principle with proofs and provides examples of applications A complete and up to date exposition of the existing theory of viscosity solutions and regular solutions of second order HJB equations in Hilbert spaces is given together with an extensive survey of other methods with a full bibliography In particular Chapter 6 written by M Fuhrman and G Tessitore surveys the theory of regular solutions of HJB equations arising in infinite dimensional stochastic control via BSDEs The book is of interest to both pure and applied researchers working in the control theory of stochastic PDEs and in PDEs in infinite dimension Readers from other fields who want to learn the basic theory will also find it useful The prerequisites are standard functional analysis the theory of semigroups of operators and its use in the study of PDEs some knowledge of the dynamic programming approach to stochastic optimal control problems in finite dimension and the basics of stochastic analysis and stochastic equations in infinite dimensional spaces

The Optimal Control of Stochastic Processes Described by Langevin's Equation James George Heller, 1965

Modeling, Stochastic Control, Optimization, and Applications George Yin, Qing Zhang, 2019-07-16 This volume collects papers based on invited talks given at the IMA workshop in Modeling Stochastic Control Optimization and Related Applications held at the Institute for Mathematics and Its Applications University of Minnesota during May and June 2018 There were four week long workshops during the conference They are 1 stochastic control computation methods and applications 2 queueing theory and networked systems 3 ecological and biological applications and 4 finance and economics applications For broader impacts researchers from different fields covering both theoretically oriented and application intensive areas were invited to participate in the conference It brought together researchers from multi disciplinary communities in applied mathematics

applied probability engineering biology ecology and networked science to review and substantially update most recent progress As an archive this volume presents some of the highlights of the workshops and collect papers covering a broad range of topics

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