# Topics in Optimal Transportation

Cédric Villani

Graduate Studies in Mathematics

Volume 58



American Mathematical Society

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# **Topics In Optimal Transportation Graduate Studies In Mathematics Vol 58:**

**Topics in Optimal Transportation** Cédric Villani, 2003 Optimal Transportation Yann Ollivier, Hervé Pajot, Cédric Villani, 2014-08-07 Lecture notes and research papers on optimal transportation its applications and interactions with other Markov Chains and Mixing Times David A. Levin, Yuval Peres, 2017-10-31 This book is an areas of mathematics introduction to the modern theory of Markov chains whose goal is to determine the rate of convergence to the stationary distribution as a function of state space size and geometry This topic has important connections to combinatorics statistical physics and theoretical computer science Many of the techniques presented originate in these disciplines The central tools for estimating convergence times including coupling strong stationary times and spectral methods are developed The authors discuss many examples including card shuffling and the Ising model from statistical mechanics and present the connection of random walks to electrical networks and apply it to estimate hitting and cover times The first edition has been used in courses in mathematics and computer science departments of numerous universities The second edition features three new chapters on monotone chains the exclusion process and stationary times and also includes smaller additions and corrections throughout Updated notes at the end of each chapter inform the reader of recent research developments the International Congress of Mathematicians Rajendra Bhatia, Arup Pal, 2010 ICM 2010 proceedings comprise a four volume set containing articles based on plenary lectures and invited section lectures the Abel and Noether lectures as well as contributions based on lectures delivered by the recipients of the Fields Medal the Nevanlinna and Chern Prizes The first volume will also contain the speeches at the opening and closing ceremonies and other highlights of the Congress

Multiscale Modeling of Pedestrian Dynamics Emiliano Cristiani, Benedetto Piccoli, Andrea Tosin, 2014-09-12 This book presents mathematical models and numerical simulations of crowd dynamics The core topic is the development of a new multiscale paradigm which bridges the microscopic and macroscopic scales taking the most from each of them for capturing the relevant clues of complexity of crowds The background idea is indeed that most of the complex trends exhibited by crowds are due to an intrinsic interplay between individual and collective behaviors The modeling approach promoted in this book pursues actively this intuition and profits from it for designing general mathematical structures susceptible of application also in fields different from the inspiring original one The book considers also the two most traditional points of view the microscopic one in which pedestrians are tracked individually and the macroscopic one in which pedestrians are assimilated to a continuum Selected existing models are critically analyzed The work is addressed to researchers and graduate students

Theory, Numerics and Applications of Hyperbolic Problems I Christian Klingenberg, Michael Westdickenberg, 2018-06-23 The first of two volumes this edited proceedings book features research presented at the XVI International Conference on Hyperbolic Problems held in Aachen Germany in summer 2016 It focuses on the theoretical applied and computational aspects of hyperbolic partial differential equations systems of hyperbolic conservation laws wave

equations etc and of related mathematical models PDEs of mixed type kinetic equations nonlocal or and discrete models found in the field of applied sciences The Mathematics Of Large-scale Atmosphere And Ocean Michael John Priestley Cullen, 2021-06-04 The high predictability of the atmosphere and ocean depends on the existence of a slow manifold which contains the solutions of equations describing only large scale motions. This unique compendium succinctly describes major recent advances in showing that these equations can be solved independently The book is a new edition of a similar book published 15 years ago The explanation of the mathematical techniques has been expanded Many new theoretical results are included Illustrations derived from production atmosphere and ocean models are also incorporated to cover the full range between rigorous mathematics and state of the art numerical modelling. The author is a dynamical meteorologist with long experience and international standing The mathematical results in the book were proved by many of the world s leading analysts The results come from the Met Office Unified Model which is one of the world's leading weather and climate models Related Link s The Methods of Distances in the Theory of Probability and Statistics Svetlozar T. Rachev, Lev Klebanov, Stoyan V. Stoyanov, Frank Fabozzi, 2013-01-04 This book covers the method of metric distances and its application in probability theory and other fields The method is fundamental in the study of limit theorems and generally in assessing the quality of approximations to a given probabilistic model The method of metric distances is developed to study stability problems and reduces to the selection of an ideal or the most appropriate metric for the problem under consideration and a comparison of probability metrics After describing the basic structure of probability metrics and providing an analysis of the topologies in the space of probability measures generated by different types of probability metrics the authors study stability problems by providing a characterization of the ideal metrics for a given problem and investigating the main relationships between different types of probability metrics. The presentation is provided in a general form although specific cases are considered as they arise in the process of finding supplementary bounds or in applications to important special cases Svetlozar T Rachev is the Frey Family Foundation Chair of Quantitative Finance Department of Applied Mathematics and Statistics SUNY Stony Brook and Chief Scientist of Finanlytica USA Lev B Klebanov is a Professor in the Department of Probability and Mathematical Statistics Charles University Prague Czech Republic Stoyan V Stoyanov is a Professor at EDHEC Business School and Head of Research EDHEC Risk Institute Asia Singapore Frank J Fabozzi is a Professor at **EDHEC Business School USA** Markov Processes, Feller Semigroups and Evolution Equations J. A. van Casteren, 2011 The book provides a systemic treatment of time dependent strong Markov processes with values in a Polish space It describes its generators and the link with stochastic differential equations in infinite dimensions In a unifying way where the square gradient operator is employed new results for backward stochastic differential equations and long time behavior are discussed in depth The book also establishes a link between propagators or evolution families with the Feller property and time inhomogeneous Markov processes This mathematical material finds its applications in several branches of

the scientific world among which are mathematical physics hedging models in financial mathematics and population models Crowd Dynamics, Volume 1 Livio Gibelli, Nicola Bellomo, 2019-01-22 This volume explores the complex problems that arise in the modeling and simulation of crowd dynamics in order to present the state of the art of this emerging field and contribute to future research activities Experts in various areas apply their unique perspectives to specific aspects of crowd dynamics covering the topic from multiple angles These include a demonstration of how virtual reality may solve dilemmas in collecting empirical data a detailed study on pedestrian movement in smoke filled environments a presentation of one dimensional conservation laws with point constraints on the flux a collection of new ideas on the modeling of crowd dynamics at the microscopic scale and others Applied mathematicians interested in crowd dynamics pedestrian movement traffic flow modeling urban planning and other topics will find this volume a valuable resource Additionally researchers in social psychology architecture and engineering may find this information relevant to their work Symmetrization in Analysis Albert Baernstein II,2019-03-14 Symmetrization is a rich area of mathematical analysis whose history reaches back to antiquity This book presents many aspects of the theory including symmetric decreasing rearrangement and circular and Steiner symmetrization in Euclidean spaces spheres and hyperbolic spaces Many energies frequencies capacities eigenvalues perimeters and function norms are shown to either decrease or increase under symmetrization. The book begins by focusing on Euclidean space building up from two point polarization with respect to hyperplanes Background material in geometric measure theory and analysis is carefully developed yielding self contained proofs of all the major theorems. This leads to the analysis of functions defined on spheres and hyperbolic spaces and then to convolutions multiple integrals and hypercontractivity of the Poisson semigroup The author's star function method which preserves subharmonicity is developed with applications to semilinear PDEs The book concludes with a thorough self contained account of the star function s role in complex analysis covering value distribution theory conformal mapping and the hyperbolic metric Introduction to **Uncertainty Quantification** T.J. Sullivan, 2015-12-14 This text provides a framework in which the main objectives of the field of uncertainty quantification UQ are defined and an overview of the range of mathematical methods by which they can be achieved Complete with exercises throughout the book will equip readers with both theoretical understanding and practical experience of the key mathematical and algorithmic tools underlying the treatment of uncertainty in modern applied mathematics Students and readers alike are encouraged to apply the mathematical methods discussed in this book to their own favorite problems to understand their strengths and weaknesses also making the text suitable for a self study Uncertainty quantification is a topic of increasing practical importance at the intersection of applied mathematics statistics computation and numerous application areas in science and engineering This text is designed as an introduction to UQ for senior undergraduate and graduate students with a mathematical or statistical background and also for researchers from the mathematical sciences or from applications areas who are interested in the field T J Sullivan was Warwick Zeeman Lecturer

at the Mathematics Institute of the University of Warwick United Kingdom from 2012 to 2015 Since 2015 he is Junior Professor of Applied Mathematics at the Free University of Berlin Germany with specialism in Uncertainty and Risk Real and Complex Submanifolds Young Jin Suh, Jürgen Berndt, Yoshihiro Ohnita, Byung Hak Kim, Hyunjin Lee, 2014-12-05 Edited in collaboration with the Grassmann Research Group this book contains many important articles delivered at the ICM 2014 Satellite Conference and the 18th International Workshop on Real and Complex Submanifolds which was held at the National Institute for Mathematical Sciences Daejeon Republic of Korea August 10 12 2014 The book covers various aspects of differential geometry focused on submanifolds symmetric spaces Riemannian and Lorentzian manifolds and K hler and Grassmann manifolds Séminaire de Probabilités XLV Catherine Donati-Martin, Antoine Lejay, Alain Rouault, 2013-07-19 The series of advanced courses initiated in S minaire de Probabilit s XXXIII continues with a course by Ivan Nourdin on Gaussian approximations using Malliavin calculus The S minaire also occasionally publishes a series of contributions on a unifying subject in this spirit selected participants to the September 2011 Conference on Stochastic Filtrations held in Strasbourg and organized by Michel mery have also contributed to the present volume The rest of the work covers a wide range of topics such as stochastic calculus and Markov processes random matrices and free probability and combinatorial optimization Convex Functions and Their Applications Constantin P. Niculescu, Lars-Erik Persson, 2025-03-11 This third edition presents an expanded and updated treatment of convex analysis methods incorporating many new results that have emerged in recent years These additions are essential for grasping the practical applications of convex function theory in solving contemporary real world problems To reflect these advancements the material has been meticulously reorganized with a greater emphasis on topics relevant to current research Additionally great care has been taken to ensure that the text remains accessible to a broad audience including both students and researchers focused on the application of mathematics Ideal for undergraduate courses graduate seminars or as a comprehensive reference this book is an indispensable resource for those seeking to understand the extensive potential of convex function theory Least Gradient Wojciech Górny, José M. Mazón, 2024-05-22 This book is devoted to the least gradient problem and its variants The least gradient problem concerns minimization of the total variation of a function with prescribed values on the boundary of a Lipschitz domain It is the model problem for studying minimization problems involving functionals with linear growth Functions which solve the least gradient problem for their own boundary data which arise naturally in the study of minimal surfaces are called functions of least gradient The main part of the book is dedicated to presenting the recent advances in this theory Among others are presented an Euler Lagrange characterization of least gradient functions an anisotropic counterpart of the least gradient problem motivated by an inverse problem in medical imaging and state of the art results concerning existence regularity and structure of solutions Moreover the authors present a surprising connection between the least gradient problem and the Monge Kantorovich optimal transport problem and some of its consequences and discuss

formulations of the least gradient problem in the nonlocal and metric settings Each chapter is followed by a discussion section concerning other research directions generalizations of presented results and presentation of some open problems The book is intended as an introduction to the theory of least gradient functions and a reference tool for a general audience in analysis and PDEs The readers are assumed to have a basic understanding of functional analysis and partial differential equations Apart from this the text is self contained and the book ends with five appendices on functions of bounded variation geometric measure theory convex analysis optimal transport and analysis in metric spaces Geometric Aspects of Functional Analysis Bo'az Klartag, Shahar Mendelson, Vitali D. Milman, 2012-07-25 This collection of original papers related to the Israeli GAFA seminar on Geometric Aspects of Functional Analysis from the years 2006 to 2011 continues the long tradition of the previous volumes which reflect the general trends of Asymptotic Geometric Analysis understood in a broad sense and are a source of inspiration for new research Most of the papers deal with various aspects of the theory including classical topics in the geometry of convex bodies inequalities involving volumes of such bodies or more generally logarithmically concave measures valuation theory probabilistic and isoperimetric problems in the combinatorial setting volume distribution on high dimensional spaces and characterization of classical constructions in Geometry and Analysis like the Legendre and Fourier transforms derivation and others All the papers here are original research papers Science of Information Frank Nielsen, Frédéric Barbaresco, 2013-08-19 This book constitutes the refereed proceedings of the First International Conference on Geometric Science of Information GSI 2013 held in Paris France in August 2013 The nearly 100 papers presented were carefully reviewed and selected from numerous submissions and are organized into the following thematic sessions Geometric Statistics on Manifolds and Lie Groups Deformations in Shape Spaces Differential Geometry in Signal Processing Relational Metric Discrete Metric Spaces Computational Information Geometry Hessian Information Geometry I and II Computational Aspects of Information Geometry in Statistics Optimization on Matrix Manifolds Optimal Transport Theory Probability on Manifolds Divergence Geometry and Ancillarity Entropic Geometry Tensor Valued Mathematical Morphology Machine Manifold Topology Learning Geometry of Audio Processing Geometry of Inverse Problems Algebraic Infinite dimensional Banach Information Manifolds Information Geometry Manifolds and Algorithms on Manifolds **Semantics of Probabilistic Processes** Yuxin Deng, 2015-02-06 This book discusses the semantic foundations of concurrent systems with nondeterministic and probabilistic behaviour Particular attention is given to clarifying the relationship between testing and simulation semantics and characterising bisimulations from metric logical and algorithmic perspectives Besides presenting recent research outcomes in probabilistic concurrency theory the book exemplifies the use of many mathematical techniques to solve problems in computer science which is intended to be accessible to postgraduate students in Computer Science and Mathematics It can also be used by researchers and practitioners either for advanced study or for technical reference

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