Department of Mathematics

2025 - Spring Semester

*(**Disclaimer**: Be advised that some information on this page may not be current due to course scheduling changes. Please view either the **UH Class Schedule page** or your Class schedule in **myUH** for the **most current/updated information**.)*

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GRADUATE COURSES - SPRING 2025

This schedule is subject to changes. Please contact the Course Instructor for confirmation.

(under construction- updated 11/18/24)

SENIOR UNDERGRADUATE COURSES

Course/Section	Class #	Course Title	Course Day/Time	Rm #	Instructor
Math 4309	11810	Mathematical Biology	MW, 2:30—4PM, (F2F)	S 115	R. Azevedo
Math 4322	14710	Introduction to Data Science and Machine Learning	TTh, 11:30AM—1PM, (F2F)	AH 110	C. Poliak
Math 4323	14260	Data Science and Statistical Learning	MWF, 10—11AM (F2F)	SEC 105	W. Wang
Math 4332/6313	10760	Introduction to Real Analysis II	MWF, 9—10AM (F2F)	S 101	M. Nicol
Math 4362	13774	Theory of Differential Equations and Nonlinear Dynamics	MWF, Noon—1PM	S 120	G. Jaramillo
Math 4364-01	12597	Intro. to Numerical Analysis in Scientific Computing	MW, 4—5:30PM	SEC 206	T. Pan

Math 4364-02	16588	Intro. to Numerical Analysis in Scientific Computing	***Asynch.*** */ on-campus exams*	Online	J. Morgan
Math 4365	12169	Numerical Methods for Differential Equations	TuTh, 11:30AM—1PM	S 101	J. He
Math 4370	21036	Mathematics for Physicists	MW, 4—5:30PM	S 119	A. Weglein
Math 4377/6308	12392	Advanced Linear Algebra I	TuTh, 11:30—1PM	SEC 203	A. Mamonov
Math 4378/6309	10761	Advanced Linear Algebra II	TuTh, 11:30—1PM	S 202	G. Heier
Math 4380	10762	A Mathematical Introduction to Options	MW, 4—5:30PM	S 132	M. Papadakis
Math 4389	10763	Survey of Undergraduate Mathematics	TuTh, 1—2:30PM	GAR G201	D. Blecher

GRADUATE ONLINE COURSES

Course/Section	Class #	Course Title	Course Day & Time	Instructor
Math 5330	11203	*Abstract Algebra*	***(Asynch.*** *online)*	*M. Ru*
Math 5332	10770	*Differential Equations*	***(Asynch.*** *online)*	*G. Etgen*
Math 5344	17857	*Intro. to Scientific Computing*	***(Asynch.*** *online)*	*J. Morgan*
Math 5385	19539	*Statistics*	***(Asynch.*** *online)*	*I. Timofeyev*

GRADUATE COURSES

Course/Section	Class #	Course Title	Course Day & Time	Rm #	Instructor
Math 6303	10771	Modern Algebra II	MWF, 11AM—Noon	S 101	A. Haynes
Math 6308	12393	Advanced Linear Algebra I	TTh, 11:30AM—1PM	SEC 203	A. Mamonov
Math 6309	11242	Advanced Linear Algebra II	TTh 11:30AM—1PM	S 202	G. Heier
Math 6313	11241	Introduction to Real Analysis	MWF, 9—10AM	S 101	M. Nicol
Math 6321	10776	Theory of Functions of a Real Variable	TTh, 10—11:30AM	S 202	B. Bodmann
Math 6367	17859	Optimization Theory	TTh, 8:30—10AM	F 154	A. Mang
Math 6371	10777	Numerical Analysis	TTh, 2:30—4PM	S 101	A. Quaini
Math 6383	10778	Statistics	MW, 1—2:30PM	MH 120	M. Jun
Math 6397	19520	Probabilistic Methods in Reinforcement and Machine Learning	TTh, 4—5:30PM	SEC 201	K. Josic

Math 6397	19521	Stochastic DE w/Applications	TTh, 1—2:30PM	CBB 124	W. Ott
Math 6397	19540	PDEs in Agent Based Modeling	TTh, 10—11:30AM	S 101	M. Perepelitsa
Math 6397	21732/21733	Bayesian Statistics	MW, 2:30—4PM	F 154	Y. Niu
Math 7321	25940	Functional Analysis	TTh, 11:30—1PM	C 137	M. Kalantar
Math 7326	19518	Dynamical Systems	MWF, 9—10AM	F 154	V. Climenhaga
Math 7352	19519	Riemannian Geometry	TTh, 2:30—4PM	F 154	Y. Wu

MSDS Courses *(MSDS Students Only)*

*(MSDS Students Only - Contact **Ms. Callista Brown** for specific class numbers)*

Course/Section	Class #	Course Title	Course Day & Time	Rm #	Instructor
Math 6359	not shown to students	Applied Statistics & Multivariate Analysis	F, 1—3PM	**CBB 110**	C. Poliak
Math 6359	not shown to students	Applied Statistics & Multivariate Analysis	F, 1—3PM (s*ynch. online)*		C. Poliak
Math 6373	not shown to students	Deep Learning and Artificial Neural Networks	MW, 1—2:30PM (F2F)	**S 101**	D. Labate
Math 6381	not shown to students	Information Visualization	F, 3—5PM	**CBB 110**	D. Shastri
Math 6381	not shown to students	Information Visualization	F, 3—5PM (s*ynch. online)*		D. Shastri
Math 6397	not shown to students	Case Studies In Data Analysis	W, 5:30—8:30PM	**SEC 205**	L. Arregoces
Math 6397	not shown to students	Financial & Commodity Markets	W, 5:30—8:30PM	**S 116**	J. Ryan

Course Details

SENIOR UNDERGRADUATE COURSES

Math 4309 - Mathematical Biology

Prerequisites:	MATH 3331 and BIOL 3306 or consent of instructor.
Text(s):	**Required texts**: A Biologist's Guide to Mathematical Modeling in Ecology and Evolution, Sarah P. Otto and Troy Day; (2007, Princeton University Press) ISBN-13:9780691123448 **Reference texts**: (excerpts will be provided) • An Introduction to Systems Biology, 2/e, U. Alon (an excellent, recently updated text on the "design principles of biological circuits") • Random Walks in Biology, H.C. Berg (a classic introduction to the applicability of diffusive processes and the Reynolds number at the cellular scale) • Mathematical Models in Biology, L. Edelstein-Keshet (a systematic development of discrete, continuous, and spatially distributed biological models) • Nonlinear Dynamics and Chaos, S.H. Strogatz (a very readable introduction to phase-plane analysis and bifurcation theory in dynamical systems with an emphasis on visual thinking; contains numerous applications in biology) • Thinking in Systems, D.H. Meadows (a lay introduction to control systems and analyzing parts-to-whole relationships, their organizational principles, and sensitivity in their design) • Adaptive Control Processes: A Guided Tour, R. Bellman (a classic, more technical introduction to self-regulating systems, feedback control, decision processes, and dynamic programming)

Description:	**Catalog description**: Topics in mathematical biology, epidemiology, population models, models of genetics and evolution, network theory, pattern formation, and neuroscience. Students may not receive credit for both MATH 4309 and BIOL 4309. **Instructor's description**: An introduction to mathematical methods for modeling biological dynamical systems. This course will survey canonical models of biological systems using the mathematics of calculus, differential equations, logic, matrix theory, and probability. Applications will span several spatial orders-of-magnitude, from the microscopic (sub-cellular), to the mesoscopic (multi-cellular tissue and organism) and macroscopic (population-level: ecological, and epidemiological) scales. Specific applications will include biological-signaling diffusion, enzyme kinetics, genetic feedback networks, population dynamics, neuroscience, and the dynamics of infectious diseases. Optional topics (depending on schedule and student interest) may be chosen from such topics as: game theory, artificial intelligence and learning, language processing, economic multi-agent modeling, Turing systems, information theory, and stochastic simulations. The course will be taught from two complementary perspectives: (1) critical analysis of biological systems' modeling using applicable mathematical tools, and (2) a deeper understanding of mathematical theory, illustrated through biological applications. Relevant mathematical theory for each course section will be reviewed from first principles, with an emphasis on bridging abstract formulations to practical modeling techniques and dynamical behavior prediction. The course will include some programming assignments, to be completed in Matlab or Python programming languages (available free through UH Software and public domain, respectively). However, advanced programming techniques are not required, and resources for introduction to these languages will be provided.

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Math 4322 - Introduction to Data Science and Machine Learning	
Prerequisites:	MATH 3339
Text(s):	Intro to Statistical Learning, Gareth James, 9781461471370
Description:	Theory and applications for such statistical learning techniques as linear and logistic regression, classification and regression trees, random forests, neutral networks. Other topics might include: fit quality assessment, model validation, resampling methods. R Statistical programming will be used throughout the course.

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Math 4323 - Data Science and Statistical Learning	
Prerequisites:	MATH 3339
Text(s):	Intro to Statistical Learning, Gareth James, 9781461471370

Description:	Theory and applications for such statistical learning techniques as maximal marginal classifiers, support vector machines, K-means and hierarchical clustering. Other topics might include: algorithm performance evaluation, cluster validation, data scaling, resampling methods. R Statistical programming will be used throughout the course.

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Math 4332/6313 - Introduction to Real Analysis II	
Prerequisites:	MATH 4331 or consent of instructor
Text(s):	Real Analysis with Real Applications | Edition: 1; Allan P. Donsig, Allan P. Donsig; ISBN: 9780130416476
Description:	Further development and applications of concepts from MATH 4331. Topics may vary depending on the instructor's choice. Possibilities include: Fourier series, point-set topology, measure theory, function spaces, and/or dynamical systems.

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Math 4362 - Theory of Differential Equations an Nonlinear Dynamics	
Prerequisites:	MATH 3331, or equivalent, and three additional hours of 3000-4000 level Mathematics.
Text(s):	Nonlinear Dynamics and Chaos (2nd Ed.) by Strogatz. ISBN: 978-0813349107
Description:	ODEs as models for systems in biology, physics, and elsewhere; existence and uniqueness of solutions; linear theory; stability of solutions; bifurcations in parameter space; applications to oscillators and classical mechanics.

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Math 4364 (12597) - Introduction to Numerical Analysis in Scientific Computing	
Prerequisites:	MATH 3331 and COSC 1410 or equivalent or consent of instructor. **Instructor's Prerequisite Notes:** 1. MATH 2331, In depth knowledge of Math 3331 (Differential Equations) or Math 3321 (Engineering Mathematics) 2. Ability to do computer assignments in FORTRAN, C, Matlab, Pascal, Mathematica or Maple.
Text(s):	Instructor's notes

Description:	**Catalog Description**: Root finding, interpolation and approximation, numerical differentiation and integration, numerical linear algebra, numerical methods for differential equations. **Instructor's Description**: This is an one semester course which introduces core areas of numerical analysis and scientific computing along with basic themes such as solving nonlinear equations, interpolation and splines fitting, curve fitting, numerical differentiation and integration, initial value problems of ordinary differential equations, direct methods for solving linear systems of equations, and finite-difference approximation to a two-points boundary value problem. This is an introductory course and will be a mix of mathematics and computing.

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Math 4364 (16588)- Introduction to Numerical Analysis in Scientific Computing	
Prerequisites:	MATH 3331 and COSC 1410 or equivalent or consent of instructor. **Instructor's Prerequisite Notes:** 1. MATH 2331, In depth knowledge of Math 3331 (Differential Equations) or Math 3321 (Engineering Mathematics) 2. Ability to do computer assignments in FORTRAN, C, Matlab, Pascal, Mathematica or Maple.
Text(s):	Numerical Analysis (9th edition), by R.L. Burden and J.D. Faires, Brooks-Cole Publishers, ISBN:9780538733519
Description:	**Catalog Description**: Root finding, interpolation and approximation, numerical differentiation and integration, numerical linear algebra, numerical methods for differential equations. **Instructor's Description**: This is an one semester course which introduces core areas of numerical analysis and scientific computing along with basic themes such as solving nonlinear equations, interpolation and splines fitting, curve fitting, numerical differentiation and integration, initial value problems of ordinary differential equations, direct methods for solving linear systems of equations, and finite-difference approximation to a two-points boundary value problem. This is an introductory course and will be a mix of mathematics and computing.

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Math 4365 - Numerical Methods for Differential Equations	
Prerequisites:	MATH 3331, or equivalent, and three additional hours of 3000–4000 level Mathematics.
Text(s):	TBA
Description:	Numerical differentiation and integration, multi-step and Runge-Kutta methods for ODEs, finite difference and finite element methods for PDEs, iterative methods for linear algebraic systems and eigenvalue computation.

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Math 4370 - Mathematics for Physicists	
Prerequisites:	MATH 2415, and MATH 3321 or MATH 3331

Text(s):	TBD
Description:	Vector calculus, tensor analysis, partial differential equations, boundary value problems, series solutions to differential equations, and special functions as applied to junior-senior level physics courses.

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Math 4377/6308 - Advanced Linear Algebra I	
Prerequisites:	MATH 2331 or equivalent, and three additional hours of 3000–4000 level Mathematics.
Text(s):	Linear Algebra | Edition: 4; Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence; ISBN: 9780130084514
Description:	Linear systems of equations, matrices, determinants, vector spaces and linear transformations, eigenvalues and eigenvectors. **Additional Notes:** This is a proof-based course. It will cover Chapters 1-4 and the first two sections of Chapter 5. Topics include systems of linear equations, vector spaces and linear transformations (developed axiomatically), matrices, determinants, eigenvectors and diagonalization.

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Math 4378/6309 - Advanced Linear Algebra II	
Prerequisites:	MATH 4377
Text(s):	Linear Algebra, Fourth Edition, by S.H. Friedberg, A.J Insel, L.E. Spence,Prentice Hall, ISBN 0-13-008451-4; 9780130084514
Description:	Similarity of matrices, diagonalization, Hermitian and positive definite matrices, normal matrices, and canonical forms, with applications. **Instructor's Additional notes:** This is the second semester of Advanced Linear Algebra. I plan to cover Chapters 5, 6, and 7 of textbook. These chapters cover Eigenvalues, Eigenvectors, Diagonalization, Cayley-Hamilton Theorem, Inner Product spaces, Gram-Schmidt, Normal Operators (in finite dimensions), Unitary and Orthogonal operators, the Singular Value Decomposition, Bilinear and Quadratic forms, Special Relativity (optional), Jordan Canonical form.

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Math 4380 - A Mathematical Introduction to Options	
Prerequisites:	MATH 2433 and MATH 3338.
Text(s):	An Introduction to Financial Option Valuation: Mathematics, Stochastics and Computation | Edition: 1; Desmond Higham; 9780521547574
Description:	Arbitrage-free pricing, stock price dynamics, call-put parity, Black-Scholes formula, hedging, pricing of European and American options.

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Math 4389 - Survey of Undergraduate Mathematics	
Prerequisites:	MATH 3330, MATH 3331, MATH 3333, and three hours of 4000-level Mathematics.
Text(s):	Instructor notes
Description:	A review of some of the most important topics in the undergraduate mathematics curriculum.

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ONLINE GRADUATE COURSES

MATH 5330 - Abstract Algebra	
Prerequisites:	Graduate standing.
Text(s):	*Abstract Algebra , A First Course* by Dan Saracino. Waveland Press, Inc. ISBN 0-88133-665-3 (You can use the first edition. The second edition contains additional chapters that cannot be covered in this course.)
Description:	Groups, rings and fields; algebra of polynomials, Euclidean rings and principal ideal domains. Does not apply toward the Master of Science in Mathematics or Applied Mathematics. **Other Notes:** This course is meant for students who wish to pursue a Master of Arts in Mathematics (MAM). Please contact me in order to find out whether this course is suitable for you and/or your degree plan. *Notice that this course **cannot** be used for MATH 3330, Abstract Algebra.*

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MATH 5332 - Differential Equations	
Prerequisites:	Graduate standing. MATH 5331.
Text(s):	The text material is posted on **Blackboard Learn**, under "**Content**".
Description:	First-order equations, existence and uniqueness theory; second and higher order linear equations; Laplace transforms; systems of linear equations; series solutions. Theory and applications emphasized throughout. Applies toward the Master of Arts in Mathematics degree; does not apply toward the Master of Science in Mathematics or the Master of Science in Applied Mathematics degrees.

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MATH 5344 - Introduction to Scientific Computing	
Prerequisites:	Graduate standing. Math 2331 linear algebra or equivalent.
Text(s):	Instructor's notes
Description:	This is an one semester course which introduces core areas of numerical analysis and scientific computing along with basic themes such as solving nonlinear equations, interpolation and splines fitting, curve fitting, numerical differentiation and integration, initial value problems of ordinary differential equations, direct methods for solving linear systems of equations, and finite-difference approximation to a two-points boundary value problem. This is an introductory course and will be a mix of mathematics and computing.

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MATH 5385 - Statistics	
Prerequisites:	**Graduate standing,** Two semesters of calculus and one semester of linear algebra or consent of instructor.
Text(s):	
Description:	Data collection and types of data, descriptive statistics, probability, estimation, model assessment, regression, analysis of categorical data, analysis of variance. Computing assignments using a prescribed software package (e.g., R or Matlab) will be given. Applies toward the Master of Arts in Mathematics degree; does not apply toward Master of Science in Mathematics or the Master of Science in Applied Mathematics degrees.

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GRADUATE COURSES

MATH 6303 - Modern Algebra II	
Prerequisites:	Graduate standing. MATH 4333 or MATH 4378 **Additional Prerequisites**: students should be comfortable with basic measure theory, groups rings and fields, and point-set topology
Text(s):	No textbook is required.
Description:	Topics from the theory of groups, rings, fields, and modules. **Additional Description:** This is primarily a course about analysis on topological groups. The aim is to explain how many of the techniques from classical and harmonic analysis can be extended to the setting of locally compact groups (i.e. groups possessing a locally compact topology which is compatible with their algebraic structure). In the first part of the course we will review basic point set topology and introduce the concept of a topological group. The examples of p-adic numbers and the Adeles will be presented in detail, and we will also spend some time discussing SL_2(R). Next we will talk about characters on topological groups, Pontryagin duality, Haar measure, the Fourier transform, and the inversion formula. We will focus on developing details in specific groups (including those mentioned above), and applications to ergodic theory and to number theory will be discussed.

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MATH 6308 - Advanced Linear Algebra I	
Prerequisites:	Graduate standing. MATH 2331 and a minimum of 3 semester hours transformations, eigenvalues and eigenvectors.
Text(s):	Linear Algebra | Edition: 4; Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence; ISBN: 9780130084514
Description:	Transformations, eigenvalues and eigenvectors. **Additional Notes:** This is a proof-based course. It will cover Chapters 1-4 and the first two sections of Chapter 5. Topics include systems of linear equations, vector spaces and linear transformations (developed axiomatically), matrices, determinants, eigenvectors and diagonalization.

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MATH 6309 - Advanced Linear Algebra II	
Prerequisites:	Graduate standing and MATH 6308
Text(s):	Linear Algebra, Fourth Edition, by S.H. Friedberg, A.J Insel, L.E. Spence,Prentice Hall, ISBN 0-13-008451-4; 9780130084514
Description:	Similarity of matrices, diagonalization, hermitian and positive definite matrices, canonical forms, normal matrices, applications. An expository paper or talk on a subject related to the course content is required.

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MATH 6313 - Introduction to Real Analysis II	
Prerequisites:	Graduate standing and MATH 6312.
Text(s):	Kenneth Davidson and Allan Donsig, “Real Analysis with Applications: Theory in Practice”, Springer, 2010; or (out of print) Kenneth Davidson and Allan Donsig, “Real Analysis with Real Applications”, Prentice Hall, 2001.
Description:	Properties of continuous functions, partial differentiation, line integrals, improper integrals, infinite series, and Stieltjes integrals. An expository paper or talk on a subject related to the course content is required.

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MATH 6321 - Theory of Functions of a Real Variable	
Prerequisites:	Graduate standing. MATH 4332 or consent of instructor. **Instructor's Prerequisite Notes:** MATH 6320
Text(s):	Primary (Required): Real Analysis for Graduate Students, Richard F. Bass Supplementary (Recommended): Real Analysis: Modern Techniques and Their Applications, Gerald Folland (2nd edition); ISBN: 9780471317166.

Description:	Lebesque measure and integration, differentiation of real functions, functions of bounded variation, absolute continuity, the classical Lp spaces, general measure theory, and elementary topics in functional analysis. **Instructor's Additional Notes:** Math 6321 is the second course in a two-semester sequence intended to introduce the theory and techniques of modern analysis. The core of the course covers elements of functional analysis, Radon measures, elements of harmonic analysis, the Fourier transform, distribution theory, and Sobolev spaces. Additonal topics will be drawn from potential theory, ergodic theory, and the calculus of variations.

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MATH 6359 (14771/15462)- Applied Statistics & Multivariate Analysis	
Prerequisites:	Graduate standing. MATH 3334, MATH 3338 or MATH 3339, and MATH 4378. Students must be in the Statistics and Data Science, MS Program
Text(s):	While lecture notes will serve as the **main source** of material for the course, the following book constitutes a great reference: - "**Statistics and Data Analysis from Elementary to Intermediate**" by Tamhane, Ajit and Dunlop, Dorothy ISBN: 0137444265 - "**Applied Multivariate Statistics with R**", by Daniel Zelterman, ISBN: 9783319140926 - "**Applied Multivariate Statistical Analysis**, sixth edition", by Richard A. Johnson and Dean W. Wichern, published by Pearson. - **Rstudio**: Make sure to download R and RStudio (which can't be installed without R) before the course starts. Use the link R download to download R frst, then RStudio download to download it from the mirror appropriate for your platform.
Description:	Linear models, loglinear models, hypothesis testing, sampling, modeling and testing of multivariate data, dimension reduction. **< Course syllabus >**

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MATH 6367 - Optimization Theory	
Prerequisites:	Graduate standing. MATH 4331 and MATH 4377.
Text(s):	• D.P. Bertsekas; Dynamic Programming and Optimal Con- trol, Vol. I, 4th Edition. Athena Scientific, 2017, ISBN-10: 1-886529-43-4 • J.R. Birge and F.V. Louveaux; Introduction to Stochastic Programming. Springer, New York, 1997, ISBN: 0-387-98217-

Description:	Constrained and unconstrained finite dimensional nonlinear programming, optimization and Euler-Lagrange equations, duality, and numerical methods. Optimization in Hilbert spaces and variational problems. Euler-Lagrange equations and theory of the second variation. Application to integral and differential equations. **Additional Description**: This course consists of two parts. The first part is concer- ned with an introduction to Stochastic Linear Programming (SLP) and Dynamic Programming (DP). As far as DP is concerned, the course focuses on the theory and the appli- cation of control problems for linear and nonlinear dynamic systems both in a deterministic and in a stochastic frame- work. Applications aim at decision problems in finance. In the second part, we deal with continuous-time systems and optimal control problems in function space with em- phasis on evolution equations.

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MATH 6371 - Numerical Analysis	
Prerequisites:	Graduate standing.
Text(s):	**Numerical Mathematics (Texts in Applied Mathematics)**, 2nd Ed., V.37, Springer, 2010. By A. Quarteroni, R. Sacco, F. Saleri. ISBN: 9783642071010
Description:	Ability to do computer assignments. Topics selected from numerical linear algebra, nonlinear equations and optimization, interpolation and approximation, numerical differentiation and integration, numerical solution of ordinary and partial differential equations.

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MATH 6373 (14772) - Deep Learning and Artificial Neural Networks	
Prerequisites:	Graduate standing. Probability/Statistic and linear algebra or consent of instructor. Students must be in Master's in Statistics and Data Science program.
Text(s):	**TBD**
Description:	Artificial neural networks for automatic classification and prediction. Training and testing of multi-layers perceptrons. Basic Deep Learning methods. Applications to real data will be studied via multiple projects.

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MATH 6381 (14970/17066) - Information Visualization	
Prerequisites:	Graduate standing. MATH 6320 or consent of instructor.
Text(s):	**TBD**
Description:	Random variables, conditional expectation, weak and strong laws of large numbers, central limit theorem, Kolmogorov extension theorem, martingales, separable processes, and Brownian motion.

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MATH 6383 (10778) - Statistics	
Prerequisites:	Graduate standing. MATH 6382 or consent of instructor.
Text(s):	TBD
Description:	A survey of statistics. Includes statistical inference using parametric and nonparametric methods.

MATH 6397 (19520) - Probabilistic Methods in Reinforcement and Machine Learning	
Prerequisites:	Graduate standing. Instructor prerequisites: Undergraduate courses in Probability and Statistics, Advanced Linear Algebra, and Stochastic Processes
Text(s):	There is no single textbook for this course, but the following references will be helpful: • R. Sutton and A. Barto. "Reinforcement learning: An introduction." (2018) • D. MacKay “Information Theory, Inference, and Learning Algorithms” • S. Amari, “Information Geometry and Its Applications” (2016). *(For topic 3 we will go over a number of papers.)*
Description:	This course is an introduction to topics that are useful in designing machine learning algorithms, as well as understanding how makes these algorithms work, and how they could be implemented both in computers, and in brains. I will cover a number of different topics, roughly divided into three parts: 1. Markov decision processes, and reinforcement learning 2. Information theory and information geometry with applications 3. Machine learning and neuroscience.

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MATH 6397 (19521) - Stochastic DE w/applications	
Prerequisites:	Graduate standing.
Text(s):	TBD
Description:	TBD

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MATH 6397 (19540) - PDEs in Agent Based Modeling	
Prerequisites:	Graduate standing.
Text(s):	Recommended: - M.Nielsen, I.Chuang, "**Quantum computation and quantum information**", Cambridge university press, 2010 - M.Wilde, "**From Classical to Quantum Shannon Theory**" arXiv:1106.1445

Description:	During the course we will cover the basics of quantum mechanics (qubits, gates, channels), universal quantum computation, quantum teleportation and other protocols, basics of quantum error-correction, and quantum algorithms (Shor's algorithm, Grover's algorithm). We will practice some of the protocols on the open access quantum computer chip made available online. No knowledge of quantum mechanics, computer science or information theory is needed. Knowledge of linear algebra and the basics of probability and complex numbers are required

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MATH 6397 (21732/21733) - Bayesian Statistics	
Prerequisites:	Graduate standing. Graduate Probability.
Text(s):	• Peter Hoff (2009). A first course in Bayesian statistical methods. Springer. • Brian J. Reich & Sujit K. Ghosh (2019). Bayesian Statistical Methods. CRC Press. • Christian P. Robert (2007). The Bayesian Choice: From Decision-Theoretic Foundations to Computational Implementation. Springer (2nd Edition).
Description:	This is an introductory course on Bayesian statistics for graduate students. The course introduces the Bayesian paradigm and focus on Bayesian modeling, computation, and inference. We first convey the ideology of Bayesian statistics which is a particular approach to statistical inference that differs philosophically and operationally from the classic frequentist approach. We then define Bayesian inference and discuss its advantages. Detailed applications are illustrated using some classical models, including binomial, Poisson, univariate normal, multivariate normal model, and linear regression. We go through each step of building Bayesian hierarchical models and apply Bayes' theorem to derive posterior distributions. To inference on posterior distributions, MCMC algorithm is introduced as a modern method of approximating posteriors

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MATH 6397 (x) - Case Studies In Data Analysis	
Prerequisites:	Graduate standing.
Text(s):	TBD
Description:	TBD

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MATH 6397 (x) - TBD	
Prerequisites:	Graduate standing.
Text(s):	TBD
Description:	TBD

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MATH 6397 (x) - Financial & Commodity Markets	
Prerequisites:	Graduate standing.
Text(s):	TBD
Description:	TBD

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MATH 7321 - Functional Analysis	
Prerequisites:	Graduate standing. MATH 7320 or instructor consent
Text(s):	W. Rudin, Functional Analysis, 2nd edition, McGraw Hill, 1991
Description:	**Catalog Description**: This course is part of a two semester sequence covering the main results in functional analysis, including Hilbert spaces, Banach spaces, and linear operators on these spaces. **Instructor's Description**: This is a continuation of what was discussed in 7320. The second semester will mostly be a more technical development of the theory of linear operators on Hilbert space and related subjects, including topics relevant in quantum theory, such as positivity and states. Some of the main topics covered include: Banach algebras and the Gelfand transform. C*-algebras and the functional calculus for normal operators. The spectral theorem for normal operators. Trace, Hilbert-Schmidt, and Schatten classes.

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MATH 7326 - Dynamical Systems	
Prerequisites:	Graduate standing. MATH 6320
Text(s):	TBD
Description:	**Catalog Description**: Ergodic theory, topological and symbolic dynamics, statistical properties, infinite-dimensional dynamical systems, random dynamical systems, and themodynamic formalism. **Instructor's Description**: TBD

MATH 7352 - Riemannian Geometry	
Prerequisites:	Graduate standing.
Text(s):	TBD
Description:	**Catalog Description**: Differentiable Manifolds, tangent space, tangent bundle, vector bundle, Riemannian metric, connections, curvature, completeness geodesics, Jacobi fields, spaces of constant curvature, and comparison theorems. **Instructor's Description**: TBD

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