



Department of Mathematics

Fall 2025

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University of Houston Textbook Adoption login (<https://uh.edu/af-auxiliary-services/campus-store/faculty-course-materials-adoptions/>).

GRADUATE COURSES - FALL 2025

SENIOR UNDERGRADUATE COURSES

Course/Section	Class #	Course Title	Course Day/Time	Rm #	Instructor
Math 4310-01	14624	Biostatistics	MWF, 10—11AM	F 162	D. Labate
Math 4320-01	11424	Intro. To Stochastic Processes	TTh, 11:30AM—1PM	SEC 202	W. Ott
Math 4322-01	24485	Intro. to Data Science and Machine Learning	TTh, 2:30—4PM	SEC 105	Y. Niu
Math 4322-02	15183	Intro. to Data Science and Machine Learning	TTh, 11:30AM—1PM	SEC 105	C. Poliak
Math 4323-01	15157	Data Science and Statistical Learning	MWF, 10—11AM	SEC 105	W. Wang
Math 4331-02	12675	Introduction to Real Analysis I	MWF, 10—11AM	CBB 106	A. Vershynina
Math 4335-01	13866	Partial Differential Equations I	TTh, 8:30—10AM	CBB 124	L. Cappanera
Math 4339-02	14725	Multivariate Statistics	TTh, 1—2:30PM	SEC 201	C. Poliak
Math 4364-01	13027	Intro. to Numerical Analysis in Scientific Computing	MW, 4—5:30PM	SEC 204	T. Pan
Math 4364-02	14983	Intro. to Numerical Analysis in Scientific Computing	TTh, 1—2:30PM	SEC 204	A. Mamonov
Math 4366-01	18762	Numerical Linear Algebra	TTh, 11:30AM—1PM	CBB 214	J. He
Math 4377-04	12677	Advanced Linear Algebra I	TTh, 8:30—10AM	CBB 106	A. Quaini
Math 4383-01	21877	Number Theory & Cryptography	MW, 1—2:30PM	CBB 214	M. Ru
Math 4388-01	12132	<i>History of Mathematics</i>	<i>Asynchronous / On Campus Exams</i>	N/A	S. Ji
Math 4389-01	11824	Survey of Undergraduate Mathematics	MWF, 9—10AM	AH 301	V. Climenhaga

GRADUATE ONLINE COURSES

Course/Section	Class #	Title	Day & Time	Instructor
Math 5310-01	16798	<i>History of Mathematics</i>	<i>Asynchronous/On-campus Exams; Online</i>	S. Ji
Math 5331-01	17646	<i>Linear Algebra w/Applications</i>	<i>Asynchronous/On-campus Exams; Online</i>	G. Etgen
Math 5333-01	16796	<i>Analysis</i>	<i>Asynchronous/On-campus Exams; Online</i>	S. Ji
Math 5382-01	15035	<i>Probability</i>	<i>Asynchronous/On-campus Exams; Online</i>	I. Timofeyev

GRADUATE COURSES

Course/Section	Class #	Course Title	Course Day & Time	Rm #	Instructor
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Math 6302-01	11425	Modern Algebra I	TTh, 11:30AM—1PM	F 162	G. Heier
Math 6304-01	21878	Theory of Matrices	TTh, 1—2:30PM	CBB 214	B. Bodmann
Math 6308-04	12678	Advanced Linear Algebra I	TTh, 8:30—10AM	CBB 106	A. Quaini
Math 6312-02	12676	Introduction to Real Analysis	MWF, 10—11AM	CBB 106	A. Vershynina
Math 6320-01	11452	Real Analysis I	TTh, 1—2:30PM	F 154	D. Blecher
Math 6322-01	16797	Function Complex Variable	MWF, Noon—1PM	SEC 203	C. Lutsko
Math 6326-01	17663	Partial Differential Equations	TTh, 10—11:30AM	CBB 214	G. Jaramillo
Math 6342-01	11453	Topology	MWF, 11AM—Noon	F 162	V. Climenhaga
Math 6366-01	11454	Optimization Theory	TTh, 2:30—4PM	CBB 214	J. He
Math 6370-01	11455	Numerical Analysis	TTh, 10—11:30AM	CBB 118	Yunhui He
Math 6376-01	21879	Numerical Linear Algebra	TTh, 11:30AM—1PM	CBB 108	M. Olshanskii
Math 6382-02	13925	Probability	MWF, 10—11AM	CBB 214	A. Haynes
Math 6389-03/06	21892/ 24302	Spatial Statistics	TTh, 1—2:30PM	SEC 205	M. Jun
Math 6397-02	21891	Math Neuroscience and Connect AI	TTh, 2:30—4PM	F 154	K. Josic
Math 6397-04	21894	Computational Math Method in Data Science	TTh, 8:30—10AM	AH 301	A. Mang
Math 6397-05	21895	Machine Learning Applications in Computer Science	TTh, 4—5:30PM	CBB 214	M. Wang

MSDS COURSES (<https://www.uh.edu/nsm/math/graduate/ms-statistics-data-science/>)

(*MSDS Students Only - Contact (</nsm/math/graduate/graduate%20courses/fall/index.php#grad>)**Ms. Tierra Kirts** (<mailto:tskirts@central.uh.edu>) for specific class numbers*)

Course-Section	Class #	Course Title	Course Day & Time	Rm #	Instructor
Math 6350-01	<i>Not shown to students</i>	Statistical Learning and Data Mining	MW, 2:30—4PM	SEC 201	J. Ryan
Math 6357-01	<i>Not shown to students</i>	Linear Models & Design of Experiments	MW, 1—2:30PM	SEC 205	W. Wang
Math 6358-02/03	<i>Not shown to students</i>	Probability Models and Statistical Computing	F, 1—3PM	CBB 122	C. Poliak
Math 6380-01/02	<i>Not shown to students</i>	Programming Foundation for Data Analytics	F, 3—5PM (F2F)/Synchronous/On-campus Exams	CBB 106	D. Shastri
Math 6393-01	<i>Not shown to students</i>	Statistics II	TTh, 10—11:30AM	CBB 110	M. Jun

SENIOR UNDERGRADUATE COURSES

Math 4310 - Biostatistics	
Prerequisites:	MATH 3339 and BIOL 3306
Text(s):	"Biostatistics: A Foundation for Analysis in the Health Sciences, Edition (TBD), by Wayne W. Daniel, Chad L. Cross. ISBN: (TBD)
Description:	Statistics for biological and biomedical data, exploratory methods, generalized linear models, analysis of variance, cross-sectional studies, and nonparametric methods. Students may not receive credit for both MATH 4310 and BIOL 4310 .

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Math 4320 - Intro to Stochastic Processes	
Prerequisites:	MATH 3338
Text(s):	- An Introduction to Stochastic Processes, by Edward P. C. Kao, Dover 2019, Duxbury Press, 1997; ISBN 9780486837925 - An Introduction to Probability with Mathematica, by Edward P. C. Kao, World Scientific, May 2022; ISBN: 9789811246784

Description:	Catalog Description: We study the theory and applications of stochastic processes. Topics include discrete-time and continuous-time Markov chains, Poisson process, branching process, Brownian motion. Considerable emphasis will be given to applications and examples. Instructor's description: This course provides a overview of stochastic processes. We cover Poisson processes, discrete-time and continuous-time Markov chains, renewal processes, diffusion process and its variants, marttingales. We also study Markov chain Monte Carlo methods, and regenerative processes. In addition to covering basic theories, we also explore applications in various areas such as mathematical finance. Syllabus can be found here: https://www.math.uh.edu/~edkao/MyWeb/doc/math4320_fall2022_syllabus.pdf 
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Math 4322 (24485) - Introduction to Data Science and Machine Learning	
Prerequisites:	MATH 3339 or MATH 3349
Text(s):	Instructor's notes. TBA
Description:	Course will deal with theory and applications for such statistical learning techniques as linear and logistic regression, classification and regression trees, random forests, neural networks. Other topics might include: fit quality assessment, model validation, resampling methods. R Statistical programming will be used throughout the course. Learning Objectives: By the end of the course a successful student should: • Have a solid conceptual grasp on the described statistical learning methods. • Be able to correctly identify the appropriate techniques to deal with particular data sets. • Have a working knowledge of R programming software in order to apply those techniques and subsequently assess the quality of fitted models. • Demonstrate the ability to clearly communicate the results of applying selected statistical learning methods to the data. Software: Make sure to download R and RStudio (which can’t be installed without R) before the course starts. Use the link https://www.rstudio.com/products/rstudio/download/ to download it from the mirror appropriate for your platform. Let me know via email in case you encounter difficulties. Course Outline: Introduction: What is Statistical Learning? Supervised and unsupervised learning. Regression and classification. Linear and Logistic Regression. Continuous response: simple and multiple linear regression. Binary response: logistic regression. Assessing quality of fit. Model Validation. Validation set approach. Cross-validation. Tree-based Models. Decision and regression trees: splitting algorithm, tree pruning. Random forests: bootstrap, bagging, random splitting. Neural Networks. Single-layer perceptron: neuron model, learning weights. Multi-Layer Perceptron: backpropagation, multi-class discrimination

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Math 4322 (15183) - Introduction to Data Science and Machine Learning	
Prerequisites:	MATH 3339 or MATH 3349
Text(s):	While lecture notes will serve as the main source of material for the course, the following book constitutes a great reference: ”An Introduction to Statistical Learning (with applications in R)” by James, Witten et al. ISBN: 978-1461471370 ”Neural Networks with R” by G. Ciaburro. ISBN: 978-1788397872

	Course will deal with theory and applications for such statistical learning techniques as linear and logistic regression, classification and regression trees, random forests, neural networks. Other topics might include: fit quality assessment, model validation, resampling methods. R Statistical programming will be used throughout the course. Learning Objectives: By the end of the course a successful student should: • Have a solid conceptual grasp on the described statistical learning methods. • Be able to correctly identify the appropriate techniques to deal with particular data sets. • Have a working knowledge of R programming software in order to apply those techniques and subsequently assess the quality of fitted models. • Demonstrate the ability to clearly communicate the results of applying selected statistical learning methods to the data.
Description:	Software: Make sure to download R and RStudio (which can't be installed without R) before the course starts. Use the link https://www.rstudio.com/products/rstudio/download/ to download it from the mirror appropriate for your platform. Let me know via email in case you encounter difficulties. Course Outline: Introduction: What is Statistical Learning? Supervised and unsupervised learning. Regression and classification. Linear and Logistic Regression. Continuous response: simple and multiple linear regression. Binary response: logistic regression. Assessing quality of fit. Model Validation. Validation set approach. Cross-validation. Tree-based Models. Decision and regression trees: splitting algorithm, tree pruning. Random forests: bootstrap, bagging, random splitting. Neural Networks. Single-layer perceptron: neuron model, learning weights. Multi-Layer Perceptron: backpropagation, multi-class discrimination

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Math 4323 - Data Science and Statistical Learning	
Prerequisites:	MATH 3339 or MATH 3349
Text(s):	Intro to Statistical Learning. ISBN: 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.

Math 4331 - Introduction to Real Analysis I	
Prerequisites:	MATH 3333. In depth knowledge of Math 3325 and Math 3333 is required.
Text(s):	Real Analysis, by N. L. Carothers; Cambridge University Press (2000), ISBN 978-0521497565
Description:	This first course in the sequence Math 4331-4332 provides a solid introduction to deeper properties of the real numbers, continuous functions, differentiability and integration needed for advanced study in mathematics, science and engineering. It is assumed that the student is familiar with the material of Math 3333, including an introduction to the real numbers, basic properties of continuous and differentiable functions on the real line, and an ability to do epsilon-delta proofs. Topics: Open and closed sets, compact and connected sets, convergence of sequences, Cauchy sequences and completeness, properties of continuous functions, fixed points and the contraction mapping principle, differentiation and integration.

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Math 4335 - Partial Differential Equations I	
Prerequisites:	MATH 3331 or equivalent, and three additional hours of 3000-4000 level Mathematics. Previous exposure to Partial Differential Equations (Math 3363) is recommended.
Text(s):	"Partial Differential Equations: An Introduction (second edition)," by Walter A. Strauss, published by Wiley, ISBN-13 978-0470-05456-7
Description:	Description:Initial and boundary value problems, waves and diffusions, reflections, boundary values, Fourier series. Instructor's Description: will cover the first 6 chapters of the textbook. See the departmental course description.

Math 4339 - Multivariate Statistics	
Prerequisites:	MATH 3349 or MATH 3349
Text(s):	- Applied Multivariate Statistical Analysis (6th Edition), Pearson. Richard A. Johnson, Dean W. Wichern. ISBN: 978-0131877153 (Required) - Using R With Multivariate Statistics (1st Edition). Schumacker, R. E. SAGE Publications. ISBN: 978-1483377964 (recommended)
Description:	Course Description: Multivariate analysis is a set of techniques used for analysis of data sets that contain more than one variable, and the techniques are especially valuable when working with correlated variables. The techniques provide a method for information extraction, regression, or classification. This includes applications of data sets using statistical software. <u>Course Objectives:</u> • Understand how to use R and R Markdown • Understand matrix algebra using R • Understand the geometry of a sample and random sampling • Understand the properties of multivariate normal distribution • Make inferences about a mean vector • Compare several multivariate means • Identify and interpret multivariate linear regression models <u>Course Topics:</u> • Introduction to R Markdown, Review of R commands (Notes) • Introduction to Multivariate Analysis (Ch.1) • Matrix Algebra, R Matrix Commands (Ch.2) • Sample Geometry and Random Sampling (Ch.3) • Multivariate Normal Distribution (Ch.4) • MANOVA (Ch.6) • Multiple Regression (Ch.7) • Logistic Regression (Notes) • Classification (Ch.11)

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Math 4364-01 (13125) - Introduction to Numerical Analysis in Scientific Computing	
Prerequisites:	MATH 3331 or MATH 3321 or equivalent, and three additional hours of 3000-4000 level Mathematics *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, 9780538733519
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.

Math 4364-02 (15232) - Introduction to Numerical Analysis in Scientific Computing	
Prerequisites:	MATH 3331 or MATH 3321 or equivalent, and three additional hours of 3000-4000 level Mathematics *Ability to do computer assignments in FORTRAN, C, Matlab, Pascal, Mathematica or Maple.
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 4366 - Numerical Linear Algebra	
Prerequisites:	MATH 2318 , or equivalent, and six additional hours of 3000-4000 level Mathematics.
Text(s):	TBA

Description:	Conditioning and stability of linear systems, matrix factorizations, direct and iterative methods for solving linear systems, computing eigenvalues and eigenvectors, introduction to linear and nonlinear optimization.
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Math 4377 - Advanced Linear Algebra I	
Prerequisites:	MATH 2331 , or equivalent, and a minimum of three semester hours of 3000-4000 level Mathematics.
Text(s):	Linear Algebra, 4th Edition, by S.H. Friedberg, A.J Insel, L.E. Spence,Prentice Hall, ISBN 0-13-008451-4
Description:	Catalog Description: Linear systems of equations, matrices, determinants, vector spaces and linear transformations, eigenvalues and eigenvectors. Instructor's Description: The course covers the following topics: vector spaces, subspaces, linear combinations,systems of linear equations, linear dependence and linear independence, bases and dimension,linear transformations, null spaces, ranges, matrix rank, matrix inverse and invertibility,determinants and their properties, eigenvalues and eigenvectors, diagonalizability.

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Math 4383 - Number Theory and Cryptography	
Prerequisites:	MATH 3330 and MATH 3336
Text(s):	Refer to the instructor's syllabus
Description:	Description: Divisibility theory, primes and their distribution, theory of congruences and application in security, integer representations, Fermat’s Little Theorem and Euler’s Theorem, primitive roots, quadratic reciprocity, and introduction to cryptography

Math 4388 - History of Mathematics	
Prerequisites:	MATH 3333
Text(s):	<i>No textbook is required. Instructor notes will be provided</i>
Description:	This course is designed to provide a college-level experience in history of mathematics. Students will understand some critical historical mathematics events, such as creation of classical Greek mathematics, and development of calculus; recognize notable mathematicians and the impact of their discoveries, such as Fermat, Descartes, Newton and Leibniz, Euler and Gauss; understand the development of certain mathematical topics, such as Pythagoras theorem, the real number theory and calculus. Aims of the course: To help students to understand the history of mathematics; to attain an orientation in the history and philosophy of mathematics; to gain an appreciation for our ancestor's effort and great contribution; to gain an appreciation for the current state of mathematics; to obtain inspiration for mathematical education, and to obtain inspiration for further development of mathematics. On-line course is taught through UH Canvas, visit http://www.uh.edu/webct/ for information on obtaining ID and password. The course will be based on my notes.

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Math 4389 - Survey of Undergraduate Mathematics	
Prerequisites:	MATH 3331 , MATH 3333 , and three hours of 4000-level Mathematics.
Text(s):	<i>No textbook is required. Instructor notes will be provided</i>
Description:	A review of some of the most important topics in the undergraduate mathematics curriculum.

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Math 4397 - Selected Topics in Math - TBD	
Prerequisites:	MATH 3333 or consent of instructor
Text(s):	TBD
Description:	Selected topics in Mathematics

Math 4397 - Selected Topics in Math - TBD	
Prerequisites:	MATH 3333 or consent of instructor
Text(s):	TBD
Description:	Selected topics in Mathematics

ONLINE GRADUATE COURSES

MATH 5310 - History of Mathematics	
Prerequisites:	Graduate standing.
Text(s):	Instructor's notes
Description:	Mathematics of the ancient world, classical Greek mathematics, the development of calculus, notable mathematicians and their accomplishments.

MATH 5331 - Linear Algebra w/Applications	
Prerequisites:	Graduate standing.
Text(s):	Linear Algebra Using MATLAB, Selected material from the text Linear Algebra and Differential Equations Using Matlab by Martin Golubitsky and Michael Dellnitz) The text will made available to enrolled students free of charge. Software: Scientific Note Book (SNB) 5.5 (available through MacKichan Software, http://www.mackichan.com/) Syllabus: Chapter 1 (1.1, 1.3, 1.4), Chapter 2 (2.1-2.5), Chapter 3 (3.1-3.8), Chapter 4 (4.1-4.4), Chapter 5 (5.1-5.2, 5.4-5-6), Chapter 6 (6.1-6.4), Chapter 7 (7.1-7.4), Chapter 8 (8.1) Project: Applications of linear algebra to demographics. To be completed by the end of the semester as part of the final.
Description:	Solving Linear Systems of Equations, Linear Maps and Matrix Algebra, Determinants and Eigenvalues, Vector Spaces, Linear Maps, Orthogonality, Symmetric Matrices, Spectral Theorem. Students will also learn how to use the computer algebra portion of SNB for completing the project.

MATH 5333 - Analysis	
Prerequisites:	Graduate standing and two semesters of Calculus.
Text(s):	Analysis with an Introduction to Proof Edition: 5, Steven R. Lay, 9780321747471
Description:	A survey of the concepts of limit, continuity, differentiation and integration for functions of one variable and functions of several variables; selected applications.

MATH 5382 - Probability	
Prerequisites:	Graduate standing. Instructor's prerequisite: Calculus 3 (multi-dimensional integrals), very minimal background in Probability.
Text(s):	Sheldon Ross, A First Course in Probability (10th Edition)
Description:	This course is for students who would like to learn about Probability concepts; I'll assume very minimal background in probability. Calculus 3 (multi-dimensional integrals) is the only prerequisite for this class. This class will emphasize practical aspects, such as analytical calculations related to conditional probability and computational aspects of probability. No measure-theoretical concepts will be covered in this class. This is class is intended for students who want to learn more practical concepts in probability. This class is particularly suitable for Master students and non-math majors.

MATH 5397 - Partial Differential Equations	
Prerequisites:	Graduate standing. Instructor's prerequisite: TBA
Text(s):	TBA
Description:	TBA

GRADUATE COURSES

MATH 6302 - Modern Algebra I	
Prerequisites:	Graduate standing.

Text(s):	Required Text: Abstract Algebra by David S. Dummit and Richard M. Foote, ISBN: 9780471433347 This book is encyclopedic with good examples and it is one of the few books that includes material for all of the four main topics we will cover: groups, rings, field, and modules. While some students find it difficult to learn solely from this book, it does provide a nice resource to be used in parallel with class notes or other sources.
Description:	We will cover basic concepts from the theories of groups, rings, fields, and modules. These topics form a basic foundation in Modern Algebra that every working mathematician should know. The Math 6302--6303 sequence also prepares students for the department's Algebra Preliminary Exam.

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MATH 6304 - Theory of Matrices	
Prerequisites:	Catalog Prerequisite: Graduate standing. Consent of instructor.
Text(s):	Matrix Analysis, by Roger A. Horn and Charles R. Johnson, 2nd edition, Cambridge University Press, 2013, ISBN 0521548233
Description:	Catalog Description: Emphasis on canonical forms and finite dimensional spectral theory.

MATH 6308 - Advanced Linear Algebra I	
Prerequisites:	Catalog Prerequisite: Graduate standing, MATH 2318 and a minimum of 3 semester hours of 3000-level mathematics
Text(s):	S.H. Friedberg, A.J. Insel, L.E. Spence, Linear Algebra, 5th Edition, Prentice Hall/Pearson
Description:	Catalog Description: Linear systems of equations, matrices, determinants, vector spaces and linear transformations, eigenvalues, and eigenvectors. An expository paper or talk on a subject related to the course content is required.

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MATH 6312 - Introduction to Real Analysis	
Prerequisites:	Graduate standing and MATH 3334.
Text(s):	A. Davidson and A. P. Donsig, Real Analysis with Real Applications. ISBN: 978-0130416476
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. Topics: The course introduces foundational ideas in real analysis, focusing on structure and behavior of functions on subsets of $\mathbb{R}^n$. Topics include: • Open and closed sets, compactness, and convergence in $\mathbb{R}^n$ • Continuity, uniform continuity, and consequences on compact sets • Differentiation and the Mean Value Theorem • Riemann integration and the Fundamental Theorem of Calculus Students will develop proof skills, explore counterexamples, and connect topological ideas with analytic results.

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MATH 6320 - Theory Functions of a Real Variable	
Prerequisites:	Graduate standing and Math 4332
Text(s):	Refer to the instructor's syllabus
Description:	Lebesgue measure and integration, differentiation of real functions, functions of bounded variation, absolute continuity, the classical L_p spaces, general measure theory, and elementary topics in functional analysis

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MATH 6322 - Function Complex Variable	
Prerequisites:	Graduate standing and MATH 4331
Text(s):	TBD
Description:	Geometry of the complex plane, mappings of the complex plane, integration, singularities, spaces of analytic functions, special function, analytic continuation, and Riemann surfaces.

MATH 6326 - Partial Differential Equations	
Prerequisites:	Graduate standing and MATH 4331

Text(s):	• Required: Lawrence C. Evans, `Partial Differential Equations', Graduate studies in mathematics 19.2 (1998).</li> <li>• <u>Optional</u>: Robert McOwen, `Partial Differential Equations, Methods and Applications', 2nd Ed. (2004)
Description:	Existence and uniqueness theory in partial differential equations; generalized solutions and convergence of approximate solutions to partial differential systems

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MATH 6342 - Topology	
Prerequisites:	Catalog prerequisite: Graduate standing. MATH 4331 . Instructor's prerequisite: Graduate standing. MATH 4331 or consent of instructor
Text(s):	(Required) Topology, A First Course, J. R. Munkres, Second Edition, Prentice-Hall Publishers. link to text
Description:	Catalog Description: Point-set topology: compactness, connectedness, quotient spaces, separation properties, Tychonoff’s theorem, the Urysohn lemma, Tietze’s theorem, and the characterization of separable metric spaces

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MATH 6350 - Statistical Learning and Data Mining	
Prerequisites:	Graduate Standing and must be in the MSDS Program . Undergraduate Courses in basic Linear Algebra and basic descriptive Statistics
Text(s):	Recommended text: Reading assignments will be a set of selected chapters extracted from the following reference text: • Introduction to Statistical Learning w/Applications in R, by James , Witten, Hastie, Tibshirani (This book is freely available online). ISBN: 9781461471370 • "Neural Networks with R” by G. Ciaburro. ISBN: 978-1788397872
Description:	Summary: A typical task of Machine Learning is to automatically classify observed "cases" or "individuals" into one of several "classes", on the basis of a fixed and possibly large number of features describing each "case". Machine Learning Algorithms (MLAs) implement computationally intensive algorithmic exploration of large set of observed cases. In supervised learning, adequate classification of cases is known for many training cases, and the MLA goal is to generate an accurate Automatic Classification of any new case. In unsupervised learning, no known classification of cases is provided, and the MLA goal is Automatic Clustering, which partitions the set of all cases into disjoint categories (discovered by the MLA). Numerous MLAs have been developed and applied to images and faces identification, speech understanding, handwriting recognition, texts classification, stock prices anticipation, biomedical data in proteomics and genomics, Web traffic monitoring, etc. This MSDSfall 2019 course will successively study : 1) Quick Review (Linear Algebra) : multi dimensional vectors, scalar products, matrices, matrix eigenvectors and eigenvalues, matrix diagonalization, positive definite matrices 2) Dimension Reduction for Data Features : Principal Components Analysis (PCA) 3) Automatic Clustering of Data Sets by K-means algorithmics 3) Quick Review (Empirical Statistics) : Histograms, Quantiles, Means, Covariance Matrices 4) Computation of Data Features Discriminative Power 5) Automatic Classification by Support Vector Machines (SVMs) Emphasis will be on concrete algorithmic implementation and testing on actual data sets, as well as on understanding importants concepts.

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MATH 6357 - Linear Models and Design of Experiments	
Prerequisites:	Graduate Standing and must be in the MSDS Program . MATH 2433, MATH 3338, MATH 3339, and MATH 6308

Text(s):	Required Text: "Neural Networks with R" by G. Ciaburro. ISBN: 9781788397872
Description:	Linear models with L-S estimation, interpretation of parameters, inference, model diagnostics, one-way and two-way ANOVA models, completely randomized design and randomized complete block designs.

MATH 6358 - Probability Models and Statistical Computing	
Prerequisites:	Graduate Standing and must be in the MSDS Program . MATH 3334, MATH 3338 and MATH 4378
Text(s):	• Required: Probability with Applications in Engineering, Science, and Technology, by Matthew A. Carlton and Jay L. Devore, 2014. • <i>Recommended:</i> Introductory Statistics in R, Peter Dalgaard, 2nd ed., Springer, 2008 • <i>Recommended:</i> Introduction to Probability Models by Sheldon Axler 11th edition • Lecture Notes
Description:	Course Description: Probability, independence, Markov property, Law of Large Numbers, major discrete and continuous distributions, joint distributions and conditional probability, models of convergence, and computational techniques based on the above. Topics Covered: • Probability spaces, random variables, axioms of probability. • Combinatorial analysis (sampling with, without replacement etc) • Independence and the Markov property. Markov chains- stochastic processes, Markov property, first step analysis, transition probability matrices. Longterm behavior of Markov chains: communicating classes, transience/recurrence, criteria for transience/recurrence, random walks on the integers. • Distribution of a random variable, distribution functions, probability density function. Independence. • Strong law of large numbers and the central limit theorem. • Major discrete distributions- Bernoulli, Binomial, Poisson, Geometric. Modeling with the major discrete distributions. • Important continuous distributions- Normal, Exponential. Beta and Gamma. • Jointly distributed random variables, joint distribution function, joint probability density function, marginal distribution. • Conditional probability- Bayes theorem. Discrete conditional distributions, continuous conditional distributions, conditional expectations and conditional probabilities. Applications of conditional probability. Software Used: • Make sure to download <u>R and RStudio</u> (which can't be installed without R) before the course starts. Use the link RStudio download to download it from the mirror appropriate for your platform. • **New: Rstudio is in the cloud: <u>RStudio.cloud</u>.

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MATH 6360 - Applicable Analysis- TBD	
Prerequisites:	Graduate standing.
Text(s):	No obligatory text. Part of the material will be collected from Ken Davidson and Alan Donsig, “Real Analysis with Applications: Theory in Practice”, Springer, 2009. Other sources on Applied Functional Analysis will complement the material.

Description:	This course covers topics in analysis that are motivated by applications. 1. Review of metric spaces, completeness, characterization of compactness, extreme value theorem. 2. Contraction mappings and fixed points. Applications of contractions mappings: integral equations, solutions to initial value problems. Local existence and uniqueness of solutions, stability. 3. Lp spaces as metric completions. Extending the Riemann integral to Lp spaces. Banach spaces. 4. Dual spaces. Uniform boundedness. 5. Consequences of uniform boundedness for Fourier series and polynomial interpolation. 6. Uniform convexity, best approximation property and duality for Lp-spaces. Bounded inverse, closed graph theorem. 7. Hilbert spaces. Orthonormal bases and their characterization. Characterization of best approximation by orthogonal projection. Fourier series. 8. Convergence in L2 and pointwise convergence. Weak convergence. 9. Nonlinear best approximations and (approximate) sparsity. 10. Relationships between weak and norm convergence. Weak compactness in Hilbert spaces. Linear and convex programming in Hilbert spaces. 11. Operators and bilinear forms. The Lax-Milgram theorem. 12. Linear inverse problems. Sparse recovery by norm minimization. 13. The Hilbert-Schmidt norm and Hilbert-Schmidt operators. Compact self-adjoint operators. The spectral theorem for compact, self-adjoint operators. 14. Diagonalizing normal operators. Solutions to Schrodinger's eigenvalue problem and compact integral operators. Introduction to the Calculus of Variations. 15. Other topics in coordination with faculty.

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MATH 6366 - Optimization Theory	
Prerequisites:	Graduate standing and MATH 4331 and MATH 4377
Text(s):	Convex Optimization, Stephen Boyd and Lieven Vandenberghe, Cambridge University Press, 2004
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

MATH 6370 - Numerical Analysis	
Prerequisites:	Graduate standing. Students should have knowledge in Calculus and Linear Algebra.
Text(s):	View the instructor's syllabus
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 6376 - Numerical Linear Algebra	
Prerequisites:	Graduate standing, MATH 6371 or consent of instructor.
Text(s):	View the instructor's syllabus
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 6380 - Programming Foundation for Data Analytics	
Prerequisites:	Graduate Standing and must be in the MSDS Program. Instructor prerequisites: The course is essentially self-contained. The necessary material from statistics and linear algebra is integrated into the course. Background in writing computer programs is preferred but not required.
Text(s):	• "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", by Wes McKinney, 2 edition, 2017, O'Reilly. (PD) Paper Book. ISBN 13: 9781491957660. <i>Available for free on Safari through UH library.</i> • "Python for Everybody (Exploring Data in Python3)", by Dr. Charles Russell Severance, 2016, 1 edition, CreateSpace Independent Publishing Platform (PE) Paper Book. ISBN 13: 9781530051120 <i>Free online copy: https://books.trinket.io/pfe/index.html</i>

Description:	Instructor's Description: The course provides essential foundations of Python programming language for developing powerful and reusable data analysis models. The students will get hands-on training on writing programs to facilitate discoveries from data. The topics include data import/export, data types, control statements, functions, basic data processing, and data visualization.
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MATH 6382 - Probability and Statistics	
Prerequisites:	MATH 3334, MATH 3338 and MATH 4378, or consent of instructor.
Text(s):	View the instructor's syllabus
Description:	A survey of probability theory and probability models. Includes basic probability theory and introduction to stochastic processes.

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MATH 6393-01 - Statistics II	
Prerequisites:	Graduate standing. MATH 6382 and MATH 6383
Text(s):	- Required text book for some homework and reference: - All of Statistics: A concise course in statistical inference. Larry Wasserman. Springer. - Other suggested reading material: - Shao. Mathematical Statistics (second edition). - Mathematical Statistics: Basic Ideas and Selected Topics, Volume I and II, Bickel and Doksum P. MuCullagh and J.A. Nelder: Generealized Linear Models, 2nd ed. 1999 Chapman Hall/CRC
Description:	This is the second of two core statistics courses on mathematical statistics and statistical inference, designed for PhD students in statistics and mathematics. The Probability course (MATH 6382) and the first-semester sequence (MATH 6383) are required prerequisites. This course will cover more advanced topics in statistical inference, statistical computation, and applied statistics. There will be some computational components, and students are expected to use R or Python for statistical computing.

Math 6397-02 (21891) - Math Neuroscience and Connect AI	
Prerequisites:	Graduate standing.
Text(s):	View the instructor's syllabus
Description:	TBA

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MATH 6389-03/06 - Spatial Statistics	
Prerequisites:	Graduate standing. MATH 6357, MATH 6358, and MATH 6359, or equivalent, or consent of instructor.
Text(s):	- Lectures will be based on lecture notes provided by the instructor. - Suggested reading material: - Statistical Methods for Spatial data Analysis by Schabenberger and Gotway, 2005; CRC Press - Statistics for spatial data by Noel Cressie, revised edition, Wiley - Statistics for spatio-temporal data by Noel Cressie and Christopher K. Wikle, 1st edition, Wiley
Description:	This is a graduate level course (multidisciplinary, for Master’s as well as PhD students) that gives a general overview of the field of spatial and spatio-temporal statistics. Students will learn concepts and statistical methods for real data with spatial and temporal dependence. Students will learn to analyze spatial and spatio-temporal data, using R or Python. Various real data application examples will be given during lectures.

MATH 6397 (21894) - Computational Math Methods in Data Science	
Prerequisites:	Graduate standing.
Text(s):	Course material and homework assignments will be made available on Canvas . Students will be assessed through practical and theoretical homework assignments and projects.

	This course provides students with the mathematical background needed to analyze, implement, and further develop numerical methods at the heart of data-enabled sciences. It is geared towards students who are interested in strengthening their theoretical foundation and honing their skills as a computational scientist and computational mathematician in the emerging field of data science and machine learning. We will review traditional approaches and explore state-of-the-art methods. This course will be a hands-on experience; while the classes will cover both theory and implementation aspects, the main focus of the assignments will be on implementation aspects. Students will learn how to write mathematical code to solve “simple” data science problems. The focus is not to apply existing methods but rather to understand the foundational concepts by implementing mathematically sound methods from scratch. This will enable students to better understand when modern machine learning methods will work, and when they will fail. Students are free to use their preferred programming language. This course will also touch up on topics in numerical analysis, numerical linear algebra, and optimization applied to machine learning and data science.
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MATH 6397 (21895) - Machine Learning Applications in Computer Science	
Prerequisites:	Graduate standing.
Text(s):	View the instructor's syllabus
Description:	TBA

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MATH 7320 - Functional Analysis- TBD	
Prerequisites:	Graduate standing. MATH 6320 or consent of instructor.
Text(s):	Walter Rudin, Functional Analysis, 2nd edition. McGraw Hill, 1991. (Instructor may suggest other tests or have their own typed notes)
Description:	Catalog description: Linear topological spaces, Banach and Hilbert spaces, duality, and spectral analysis. Instructor's description: TBD

MATH 7350 - Geometry of Manifolds- TBD	
Prerequisites:	Graduate standing. MATH 3431 and MATH 3333
Text(s):	View the instructor's syllabus
Description:	Manifolds and tangent bundles, submanifolds and imbeddings, integral manifolds, triangulation of manifolds, connections and holonomy; Riemannian geometry, surface theory, Morse theory, and G-structures.

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MATH 7397 - Numerical Linear Algebra - Data- TBD	
Prerequisites:	Graduate standing. MATH 3431 and MATH 3333
Text(s):	View the instructor's syllabus
Description:	Manifolds and tangent bundles, submanifolds and imbeddings, integral manifolds, triangulation of manifolds, connections and holonomy; Riemannian geometry, surface theory, Morse theory, and G-structures.

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