Department of Mathematics

2019 - 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**.)*

GRADUATE COURSES - SPRING 2019

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

SENIOR UNDERGRADUATE COURSES

Course	Class #	Course Title	Course Day & Time	Rm #	Instructor
Math 4309	6259	Mathematical Biology	MW, 2:30—4:00PM	SEC 104	R. Azevedo
Math 4315	12147	Graph Theory w/Applications	TuTh, 4:00—5:30PM	SEC 202	K. Josic
Math 4332/6313	2895	Introduction to Real Analysis II	TuTh, 2:30—4:00PM	AH 301	M. Kalantar
Math 4351	13920	Differential Geometry II	TuTh, 1:00—2:30PM	SEC 203	M. Ru
Math 4362	13921	Theory of Differential Equations and Nonlinear Dynamics	TuTh, 4:00—5:30PM	AH 302	W. Ott
Math 4364	9310	Intro. to Numerical Analysis in Scientific Computing	MW, 4:00—5:30PM	D2 LECT2	T.W. Pan
Math 4364	17945	Intro. to Numerical Analysis in Scientific Computing	Online	Online	J. Morgan
Math 4365	7697	Numerical Methods for Differential Equations	TuTh, 11:30AM—1PM	CBB 120	J. He
Math 4377/6308	5199	Advanced Linear Algebra I	MWF, Noon—1:00PM	SEC 103	D. Wagner
Math 4378/6309	2896	Advanced Linear Algebra II	TuTh, 11:30AM—1PM	F 154	A. Mamonov
Math 4380	2897	A Mathematical Introduction to Options	MW, 1—2:30PM	SEC 105	I. Timofeyev
Math 4389	2898	Survey of Undergraduate Mathematics	MWF, Noon—1PM	SEC 205	M. Almus

Math 4397	14519	Statistical & Machine Learning	MWF, 11am—Noon	GAR 201	A. Skripnikov/C. Poliak

GRADUATE ONLINE COURSES

Course	Class #	Course Title	Course Day & Time	Instructor
Math 5330	4255	Abstract Algebra	Arrange (online course)	K. Kaiser
Math 5332	2917	Differential Equations	Arrange (online course)	G. Etgen
Math 5334	13922	Complex Analysis	Arrange (online course)	S. Ji
Math 5344	18243	Introduction to Scientific Computing	Arrange (online course)	J. Morgan
Math 5386	5938	Regression and Linear Models	Arrange (online course)	C. Peters

GRADUATE COURSES

Course	Class #	Course Title	Course Day & Time	Rm #	Instructor
Math 6303	2924	Modern Algebra II	MW, 1—2:30pm	C 105	G. Heier
Math 6308	4421	Advanced Linear Algebra I	MWF, Noon—1pm	SEC 103	D. Wagner
Math 6308	8599	Advanced Linear Algebra I (online)	Online	Online	TBA
Math 6309	4429	Advanced Linear Algebra II	TuTh, 11:30am—1pm	F 154	A. Mamonov
Math 6313	4420	Introduction to Real Analysis	TuTh, 2:30—4pm	C 106	M. Kalantar
Math 6321	2941	Theory of Functions of a Real Variable	MWF, 11am—Noon	AH 108	M. Tomforde
Math 6323	13923	Functional Complex Variable	MWF, 9—10am	AH 301	S. Ji
Math 6361	4424	Applicable Analysis	MWF, 10—11am	AH 301	B. Bodmann
Math 6365	12154	Automatic Learning and Data Mining	TuTh, 11:30am—1pm	CBB 124	R. Azencott
Math 6367	2942	Optimization Theory	MW, 4—5:30pm	SEC 206	R. Hoppe
Math 6371	2943	Numerical Analysis	MW, 1—2:30pm	AH 303	Y. Kuznetsov
Math 6383	2944	Probability Statistics	TuTh, 4—5:30pm	AH 7	W. Fu
Math 6385	12153	Continuous-Time Models in Finance	TuTh, 2:30—4pm	F 162	E. Kao
Math 6397	13924	Sobolev Calculus & Sobolev Spaces	TuTh, 1—2:30pm	AH 203	G. Auchmuty
Math 6397	13925	Time Series Analysis	TuTh, 10—11:30am	AH 203	E. Kao
Math 7321	13926	Functional Analysis	MWF, Noon—1pm	AH 301	D. Blecher
Math 7350	13927	Geometry of Manifolds	TuTh, 11:30am—1pm	SW 423	A. Török
Math 7394	13929	Ergodic Theory & Thermodynamic Formalism	MWF, 11am—Noon	AH 2	V. Climenhaga
Math 7396	13930	Multigrid Methods	MW, 4—5:30pm	AH 301	M. Olshanskiy

---Course Details---

SENIOR UNDERGRADUATE COURSES

Math 4309 (6259) - Mathematical Biology

Prerequisites:	MATH 3331 and BIOL 3306 or consent of instructor.
Text(s):	A Biologist's Guide to Mathematical Modeling in Ecology and Evolution by Sarah P. Otto and Troy Day; ISBN-13:9780691123448
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.

<< back to top >>

Math 4315 (12147) - Graph Theory w/Applications

Prerequisites:	Either MATH 3330 or MATH 3336 and three additional hours of 3000-4000 level Mathematics
Text(s):	Networks, Crowds, and Markets: Reasoning About a Highly Connected World. By David Easley and Jon Kleinberg. This text is availabe at this link: https://www.cs.cornell.edu/home/kleinber/networks-book/
Description:	Introduction to basic concepts, results, methods, and applications of graph theory. **Additional Description**: How does information propagate between friends and acquaintances on social media? How do diseases spread, and when do epidemics start? How should we design power grids to avoid failures, and systems of roads to optimize traffic flow? These questions can be addressed using network theory . Students in the course will develop a sound knowledge of the basics of graph theory, as well as some of the computational tools used to address the questions above. Course topics include basic structural features of networks, generative models of networks, centrality, random graphs, clustering, and dynamical processes on graphs.

<< back to top >>

Math 4332 (2895) - 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.

Math 4351 (13920) - Differential Geometry II

Prerequisites: MATH 4350.

Text(s): Instructor's notes will be provided.

Description: Continuation of the study of Differential Geometry from MATH 4350. Holonomy and the Gauss-Bonnet theorem, introduction to hyperbolic geometry, surface theory with differential forms, calculus of variations and surfaces of constant mean curvature, abstract surfaces (2D Riemannian manifolds).

<< back to top >>

Math 4362 (13921) - 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.

<< back to top >>

Math 4364 (9310)- 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: 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.

<< back to top >>

Math 4364 (17945)- 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:	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.

<< back to top >>

Math 4365 (7397) - Numerical Methods for Differential Equations

Prerequisites:	MATH 3331, or equivalent, and three additional hours of 3000–4000 level Mathematics.
Text(s):	TITLE:TBA, AUTHOR:TBA, ISBN: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.

<< back to top >>

Math 4377 (5199) - 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.

<< back to top >>

Math 4378 (2896) - 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.

<< back to top >>

Math 4380 (2897) - 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.

<< back to top >>

Math 4389 (2898) - Survey of Undergraduate Mathematics

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

<< back to top >>

Math 4397 (14519) - Statistical & Machine Learning

Prerequisites:	**Catalog Prerequisite**: MATH 3333 or approval of the instructor. **Instructor Prerequisite:** MATH 3339
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.
Description:	**Instructor's Description**: Course will deal with applications for such statistical learning techniques as maximal margin 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. **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.

<< back to top >>

ONLINE GRADUATE COURSES

<< back to top >>

MATH 5330 (4255) - 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.*

<< back to top >>

MATH 5332 (2917) - Differential Equations

Prerequisites:	Graduate standing. MATH 5331.
Text(s):	TBA
Description:	Linear and nonlinear systems of ordinary differential equations; existence, uniqueness and stability of solutions; initial value problems; higher dimensional systems; Laplace transforms. Theory and applications illustrated by computer assignments and projects. 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.

MATH 5334 (13922) - Complex Analysis

Prerequisites:	Graduate standing. and two semesters of calculus.
Text(s):	The course will be based on my notes.
Description:	This course is an introduction to complex analysis. It will cover the theory of holomorphic functions, Cauchy theorem and Cauchy integral formula, residue theorem, harmonic and subharmonic functions, and other topics. On-line course is taught through Blackboard Learn, visit http://www.uh.edu/webct/ for information on obtaining ID and password. In each week, some lecture notes will be posted in Blackboard Learn, including homework assignment. Homework will be turned in by the required date through Blackboard Learn. It must be in pdf file. There are two exams. Homework and test problems are mostly computational in nature.

<< back to top >>

<< back to top >>

MATH 5344 (13922) - Introduction to Scientific Computing w/Excel

Prerequisites:

Graduate standing and three semesters of Calculus.

MATH 2331, In depth knowledge of Math 3331 (Differential Equations) or Math 3321 (Engineering Mathematics)

(see the description for more prerequisite details)

Text(s):

Numerical Analysis (9th edition), by R.L. Burden and J.D. Faires, Brooks-Cole Publishers, 9780538733519

Description:

The students in this online section will be introduced to topics in scientific computing, including numerical solutions to nonlinear equations, numerical differentiation and integration, numerical solutions of systems of linear equations, least squares solutions and multiple regression, numerical solutions of nonlinear systems of equations, numerical optimization, numerical solutions to discrete dynamical systems, and numerical solutions to initial value problems and boundary value problems. Computations in this course will primarily be illustrated directly in an Excel spreadsheet, or via VBA programming, but students who prefer to do their computations using Matlab, Julia, Python or some other programming language are also welcome. For students who want to do their computing in Excel, there will be tutorials associated with the use of Excel, and programming in VBA. Students who decide to use Excel are expected to have access and basic familiarity with Excel, but they are not expected to know advanced spreadsheet functionality or have programming experience with VBA. Students will not be tested over Excel or VBA, and students using Matlab, Julia or Python will also receive some help materials.

<< back to top >>

MATH 5386 (5938) - Regression and Linear Models *(VEE approved course)*

Prerequisites:

Graduate standing. Two semesters of calculus, one semester of linear algebra, and MATH 5385, or consent of instructor.

Text(s):

Introduction to Linear Regression Analysis | Edition:5; Montgomery, Peck, Vining;
ISBN: 9780470542811; Wiley

Description:

Simple and multiple linear regression, linear models, inferences from the normal error model, regression diagnostics and robust regression, computing assignments with appropriate software. Applies toward 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.

Note: This course is VEE approved for the regression component only. Approval Code: 4458-11008. For more information on VEE approved courses, click here.

<< back to top >>

GRADUATE COURSES

<< back to top >>

MATH 6303 (2924) - 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.

<< back to top >>

MATH 6308 (4421) - 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.

<< back to top >>

MATH 6308 (8599) - Advanced Linear Algebra I *(online)*

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. An expository paper or talk on a subject related to the course content is required Syllabus

<< back to top >>

MATH 6309 (4429) - 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.

<< back to top >>

MATH 6313 (4420) - Introduction to Real Analysis II

Prerequisites:	Graduate standing and MATH 6312.
Text(s):	TBA
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.

<< back to top >>

MATH 6321 (2941) - Theory of Functions of a Real Variable II

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.

<< back to top >>

MATH 6323 (13923) - Functional Complex Variable

Prerequisites: Graduate standing. Math 6322 or consent of instructor.

Text(s): No textbook required. Lecture notes provided.

Description: Classical examples, Schwartz lemma, Riemann mapping theorem, complex hyperbolic geometry, Little and Picard theorems, Riemann surface theory and others.

<< back to top >>

<< back to top >>

MATH 6361 (4424) - Applicable Analysis

Prerequisites: Graduate standing. MATH 4332 or consent of instructor.

Text(s): The instructor will provide lecture notes on the material. A reference text is L.D. Berkowitz, Convexity and Optimization in Rn, Wiley-Interscience 2002.

Description: This course provides an introduction to the mathematical analysis of finite dimensional optimization problems. Topics to be studied include the existence of, and the extremality conditions that hold at, solutions of constrained and unconstrained optimaization problems. Elementary theory of convex sets, functions and constructions from convex analysis will be introduced and used. Concepts include subgradients, conjugate functions and some duality theory. Specific problems to be studied include energy and least squares methods for solving linear equations, important inequalities, eigenproblems and some nonlinear programming problems from applications.

<< back to top >>

MATH 6365 (12154) - Automatic Learning and Data Mining

Prerequisites: Graduate standing. MATH 3338 and MATH 3339.

Text(s): The instructor will provide lecture notes on the material. A reference text is L.D. Berkowitz, Convexity and Optimization in Rn, Wiley-Interscience 2002.

Description: Automatic learning and data mining cluster high-dimension inputs to predict their impact on decision outputs. Kernel based Clustering and Learning enable dictionary generation, pattern classification, non linear regression. Applications: shape recognition, genes expression analysis, etc.

<< back to top >>

MATH 6365 (13334) - Automatic Learning and Data Mining

Prerequisites: Graduate standing. MATH 3338 and MATH 3339.

Text(s): The instructor will provide lecture notes on the material. A reference text is L.D. Berkowitz, Convexity and Optimization in Rn, Wiley-Interscience 2002.

Description: Automatic learning and data mining cluster high-dimension inputs to predict their impact on decision outputs. Kernel based Clustering and Learning enable dictionary generation, pattern classification, non linear regression. Applications: shape recognition, genes expression analysis, etc.

<< back to top >>

MATH 6367 (2942) - 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.

<< back to top >>

MATH 6371 (2943) - 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.

<< back to top >>

MATH 6383 (2944) - Probability Statistics

Prerequisites: Graduate standing. MATH 3334, MATH 3338 and MATH 4378.

Text(s):

Recommended Text: John A. Rice : Mathematical Statistics and Data Analysis, 3rd editionBrooks / Cole, 2007. ISBN-13: 978-0-534-39942-9.

Reference Texts:

-P. MuCullagh and J.A. Nelder: Generealized Linear Models, 2nd ed. 1999 Chapman Hall/CRC. ISBN: 978-0412317606

-Raymond H. Myers, Douglas C. Montgomery, G. Geoffrey Vining, Timothy J. Robinson, Generalized Linear Models: with Applications in Engineering and the Sciences, 2nd ed. Wiley, 2010. ISBN: 978-0-470-45463-3.

Description:	A survey of probability theory, probability models, and statistical inference. Includes basic probability theory, stochastic processes, parametric and nonparametric methods of statistics. **Instructor's Description:** This course is designed for graduate students who have been exposed to basic probability and statistics and would like to learn more advanced statistical theory and techniques in modelling data of various types, including continuous, binary, counts and others. The selected topics will include basic probability distributions, likelihood function and parameter estimation, hypothesis testing, regression models for continuous and categorical response variables, variable selection methods, model selection, large sample theory, shrinkage models, ANOVA and some recent advances.

<< back to top >>

<< back to top >>

MATH 6385 (12153) - Continuous-Time Models in Finance

Prerequisites:	Graduate Standing. MATH 6384
Text(s):	Arbitrage Theory in Continuous Time, 3rd edition, by Tomas Bjork, Oxford University Press, 2009. (Primary)
Description:	Stochastic calculus, Brownian motion, change of measures, Martingale representation theorem, pricing financial derivatives whose underlying assets are equities, foreign exchanges, and fixed income securities, single-factor and multi-factor HJM models, and models involving jump diffusion and mean reversion. **Additional Description:** The course is an introduction to continuous-time models in finance. We first cover tools for pricing contingency claims. They include stochastic calculus, Brownian motion, change of measures, and martingale representation theorem. We then apply these ideas in pricing financial derivatives whose underlying assets are equities, foreign exchanges, and fixed income securities. In addition, we will study models involving jump diffusion and mean reversion and the use of levy processes in finance.

<< back to top >>

MATH 6397 (13924) - Introduction to Sobolev Calculus and Sobolev Spaces

Prerequisites:	Graduate standing.

Text(s):	There is no specific text for the course and the instructor will provide references for different parts of the material and some of his own notes. Three good **references** are specific chapters in the texts of: K. Atkinson and W. Han, Theoretical Numerical Analysis, Texts in Applied Mathematics. Vol 39, Springer 2001. A. Bressan, Lecture Notes on Functional Analysis with Applications to Linear Partial Differential Equations, Graduate Studies in Mathematics, Vol 143, American Math Society, 2013. H. Brezis, Functional Analysis, Sobolev Spaces and Partial Differential equations, Springer 2011.
Description:	This course is an introduction to the theory of weak derivatives and Sobolev spaces as used currently in the analysis of partial differential equations and numerical analysis. The rules of calculus change substantially when derivatives are defined in a weak sense. Conditions for product or chain rules to hold are quite different from those in the classical theorems. Many functions with singularities and corners may have weak derivatives with nice properties and various formulae hold with extra terms or different interpretations. In many engineering models and physical problems the analysis using weak derivatives produces results that better describe the observed behavior. The **prerequisites** for this course are classical multivariate calculus, and knowledge of Lebesgue and Borel measure on R^N and elementary Banach and Hilbert space theory as in graduate Real Analysis M6320 or equivalent. First weak derivatives of $L^1{}_{loc}$– functions on open subsets $\Omega \subset R^N$ will be defined. The definition generalizes the classical definition in some ways and is not a pointwise definition. These definitions enable the statement and proof of weak versions of the basic theorems of both 1-dimensional and multivariate calculus. These include the product rule, the chain rule, the fundamental theorem of calculus and the Gauss-Green (divergence) theorem. Then some results that only hold for weak derivatives will be proved starting with results on commutativity of weak derivatives the derivatives of convolutions, of infs and sups of pairs of functions and the approximation of measurable functions using mollifiers. Sobolev spaces such as $H^1(\Omega)$, $W^{1,p}(\Omega)$, $H(div, \Omega)$ and others will be defined and their properties described. These included completeness and imbedding theorems, the Poincar'e and Friedrich's inequalities and Rellich type theorems. Also some results about trace operators, spaces and equivalent inner products and norms. If time permits, some results about $W^{1,p}(R^N)$ and the Sobolev and Morrey embedding theorems will be treated.

<< back to top >>

MATH 6397 (13925) - Time Series Analysis

Prerequisites:	Graduate standing.
Text(s):	An Introduction to Analysis of Financial Data with R, by Ruey S. Tsay, Wiley, 2013.

	May be repeated with approval of chair.
Description:	**Additional Description:** The course is about time analysis with special emphases on financial and energy data. The course covers ARIMA models, ARCH/GARCH models, nonlinear models, high frequency data analysis, parameter estimation for diffusion and related processes, multivariate time series, extreme value analysis, Copulas, Levy processes, and an introduction of Markov chain Monte Carlo Methods. We will use R for computing.

<< back to top >>

MATH 7321 (13926) - Functional Analysis II

Prerequisites:	Graduate standing and **MATH 7320** or instructor consent
Text(s):	**Instructor Notes:** Xeroxed set of lecture notes will be available. *Recommended texts*:Pedersen's "Analysis Now" or Conway's "A Course in Functional Analysis".
Description:	Catalog Description: This course is part of a two semester sequence covering the main results in functional analysis, including Hilbert spaces, Banach spaces, topological vector spaces such as distributions, 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. We will also cover topics which the students request as time permits. 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. Unbounded operators (e.g. Extensions and closed operators, Cayley transform and the spectrum, the spectral theorem, Stone's theorem and the uncertainty principle). Student projects (such as the theory of von Neumann algebras, etc).

<< back to top >>

MATH 7350 (13927) - Geometry Manifolds

Prerequisites:	Graduate standing. Instructor's Prerequisite: Math 4331 and familiarity with multivariable calculus (at least at the level of Math 2433-Calculus III) or consent of the instructor

Text(s):	**Recommended**: John M. Lee, Introduction to Smooth Manifolds, **2nd edition** other relevant books will be placed on reserve in the library
Description:	This course describes the basic notions and constructions of differential geometry, and some of the more advanced results. It includes: manifolds, the inverse and implicit function theorems, submanifolds, partitions of unity; tangent bundles, vector fields, the Frobenius theorem, Lie derivatives, vector bundles; differential forms, tensors and tensor fieldson manifolds; exterior algebra, orientation, integration on manifolds, Stokes' theorem; Lie groups. A few additional topics might be also covered, depending on the interest of the audience.

<< back to top >>

MATH 7394 (13929) - Ergodic Theory & Thermodynamic Formalism

Prerequisites:	Graduate standing.
Text(s):	The primary text is “An Introduction to Ergodic Theory”, by Peter Walters. Another useful textbook is “Foundations of Ergodic Theory”, by Marcelo Viana and Krerley Oliveira. I will also refer to “Equilibrium States and the Ergodic Theory of Anosov Diffeomorphisms”, by Rufus Bowen, as well as various other primary sources from the research literature.
Description:	Ergodic theory is a central part of the theory of dynamical systems, studying the asymptotic statistical properties of systems evolving in time that preserve an invariant measure. Systems with chaotic behavior generally possess many invariant measures, and thermodynamic formalism borrows tools from statistical mechanics to select a distinguished measure that is physically relevant. The first part of the class will cover topics in classical ergodic theory, including Birkhoff’s ergodic theorem, entropy, and the classification of Bernoulli automorphisms. The remainder of the course will discuss thermodynamic formalism, including the description of Sinai-Ruelle-Bowen measure via absolute continuity, the description of Parry measure via a variational principle, and the connection between the two via the general theory of equilibrium states. Some time will be spent describing the different approaches to thermodynamic formalism and SRB measures in uniform hyperbolicity: Ruelle-Perron-Frobenius operators indirectly via symbolic dynamics or directly via anisotropic Banach spaces; specification and expansivity; and the geometric approach via averaged pushforwards. Time permitting, we will discuss connections to dimension theory and geometric measure theory, and will conclude with a discussion of the nonuniformly hyperbolic setting.

<< back to top >>

MATH 7396 (13927) - Multigrid Methods

Prerequisites:	Graduate standing.
Text(s):	TBA
Description:	TBA

<< back to top >>