Department of Mathematics

Fall 2013

I. GRADUATE COURSE CATALOG

II. GRADUATE COURSE Fall 2013 - (08/26/2013 - 12/20/2013)

SENIOR UNDERGRADUATE COURSES

Math 4310 - Section# 19037 - Biostatistics - by C. Peters
Math 4320 - Section# 15575 - Introduction to Stochastic Processes - by I. Timofeyev
Math 4331 - Section# 16543 - Introduction to Real Analysis - by B. Bodmann
Math 4362 - Section# 21950 - Theory of Ordinary Differential Equations - by D. Onofrei
Math 4364 - Section# 15576 - Numerical Analysis - by Y. Kuznetsov
Math 4377 - Section# 16542 - Advanced Linear Algebra I - by Z. Kilpatrick
Math 4377* - Section# 18075 - Advanced Linear Algebra I - by V. Climenhaga
Math 4383 - Section# 21951 - Number Theory- by M. Ru
Math 4388 - Section# 19287 - History of mathematics (online) - by S. Ji
Math 4389 - Section# 17436 - Survey of Undergraduate Mathematics (Online)- by C. Peters

GRADUATE ONLINE COURSES

Math 5331 - Section# 18077 - Linear algebra with applications - by K. Kaiser
Math 5333 - Section# 20155 - Analysis - by G. Egten
Math 5385 - Section# 16546 - Statistics - by C. Peteres
Math 5347 - Section# 25698 - Technology in Mathematical Classes - by A. Torok
Math 5397 - Section# 21953 - Scientific Computing with Excel - by J. Morgan

GRADUATE COURSES

Math 6302 - Section# 15589 - Modern Algebra (G. Heier)
Math 6308 - Section# 16544 - Advanced Linear Algebra I (Z. Kilpatrick)
Math 6308* - Section# 18076 - Advanced Linear Algebra I (V. Climenhaga)
Math 6312 - Section# 16545 - Introduction to Real Analysis (B. Bodmann)
Math 6320 - Section# 15622 - Theory of Functions of a Real Variable (D. Blecher)
Math 6322 - Section# 21954 - Theory of Functions of a Complex Variable (S. Ji)
Math 6326* - Section# 21955 - Partial Differential Equations (Y. Gorb)
Math 6342 - Section# 15623 - Topology (M. Tomforde)
Math 6360 - Section# 16517 - Applicable Analysis (G. Auchmuty)
Math 6366* - Section# 15624 - Optimization and Variational Methods (J. He)
Math 6370 - Section# 15625 - Numerical Analysis (M. Olshanskii)
Math 6374 - Section# 21956 - Numerical Partial Differential Equations (R. Hoppe)
Math 6382 - Section# 15626 - Probability Models and Mathematical Statistics (K. Josic)

Math 6384 - Section# 15627 - Discrete -Time Models in Finance (E. Kao)
Math 6395 - Section# 21957 - Stochastic Differential Equations (A. Torok)
Math 6395* - Section# 21958 - Frames, Wavelets and Sparse Representations (M. Papadakis)
Math 6395 - Section# 21959 - Hyperbolic Conservation Law and Numerical Methods (J. Qiu)
Math 6397- Section# 21960 - An Introduction to Reproducing kernel Hilbert Spaces (V. Paulsen)
Math 6397 - Section# 21961 - Riemannian geometry (M. Ru)
Math 6397 - Section# 21962 - Dynamical system (W. Ott)

*** : This course also has an online version.**

III. HOW TO REGISTER COURSES

1. Log in to My UH (People Soft)
2. Select "UH Self-Service"
3. Select "Enrollment"
4. Select "Enrollment: add classes" and choose the semester in which you would like to be enrolled.
5. Enter the specific section number for the class.
6. Continue to add more courses if needed and continue to finish the enrollment process.

IV. ARCHIVE OF PREVIOUS COURSES

SENIOR UNDERGRADUATE COURSES

Math 4310 Biostatistics (Section# 19037)

Time:	MoWeFr 11:00AM - 12:00PM - Room: SEC 205
Instructor:	C. Peters
Prerequisites:	
Text(s):	
Description:	

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Math 4320 Introduction to Stochastic Processes (Section# 15575)

Time:	TuTh 4:00PM - 5:30PM - Room: AH16
Instructor:	I. Timofeyev
Prerequisites:	Math 3338
Text(s):	"An Introduction to Stochastic Modeling" by Mark Pinsky, Samuel Karlin. Academic Press, Fourth Edition. ISBN-10: 9780123814166 ISBN-13: 978-0123814166

Description: We study the theory and applications of stochastic processes. Topics include Markov chains, Poisson processes, renewal phenomena, Brownian motion, and an introduction to stochastic calculus.

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Math 4331 Introduction to Real Analysis (Section# 16543)

Time: TuTh 10:00AM - 11:30AM - Room: GAR 201
Instructor: B. Bodmann
Prerequisites: Math 3333
Text(s): Maxwell Rosenlicht, Introduction to Analysis, Dover, 1968 and supplementary notes

Description:

This first course in the sequence Math 4331-4332 provides a solid introduction to deeper properties of the real numbers, continuous functions, and differentiability 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: Metric spaces, open and closed sets, compact and connected sets, convergence of sequences, Cauchy sequences and completeness, properties of continuous functions, contraction mapping principle, countable and uncountable sets, Riemann-Stieltjes integration.

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Math 4362 Theory of Ordinary Differential Equations (Section# 21950)

Time: MoWeFr 12:00PM - 1:00PM - Room: F 162
Instructor: D. Onofrei
Prerequisites: Basic linear algebra, Calculus sequence, and Math 3333.
Text(s): Paul Waltman, A second course in Elementary Differential Equations, Academic Press, Inc.
Description:

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Math 4364 Numerical Analysis (Section# 15576)

Time: MoWe 1:00PM - 2:30PM - Room: C 106
Instructor: Y. Kuznetsov
Prerequisites:
Text(s):
Description:

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Math 4377 Advanced Linear Algebra I (Section# 16542)

Time: TuTh 11:30AM - 1:00PM - Room: F 154
Instructor: Z. Kilpatrick
Prerequisites: MATH 2331 and a minimum of three semester hours of 3000-level mathematics.
Text(s): Linear Algebra and Its Applications by Peter D. Lax, 2nd edition, 2007.
Description: Linear systems of equations, matrices, determinants, vector spaces and linear transformations, eigenvalues and eigenvectors, spectral theory, matrix inequalities, linear mappings, applications including kinematics.

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Math 4377 Advanced Linear Algebra I (Section# 18075)

Time: MoWe 4:00PM - 5:30PM - Room: F 154
Instructor: V. Climenhaga

Prerequisites:	MATH 2331 and a minimum of three semester hours of 3000-level mathematics.
Text(s):	Linear Algebra and Its Applications by Peter D. Lax, 2nd edition, 2007.
Description:	Linear systems of equations, matrices, determinants, vector spaces and linear transformations, eigenvalues and eigenvectors, spectral theory, matrix inequalities, linear mappings, applications including kinematics.
Remark:	This course will be taught in classroom and also can be taken as an online course.

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Math 4383 Number theory (Section# 21951)

Time:	TuTh 1:00PM - 2:30PM - Room: FH 213
Instructor:	M. Ru
Prerequisites:	Math 3330
Text(s):	Elementary Number Theory by David M. Burton 7th Edition McGraw-Hill
Description:	This course will cover the topics in the standard one semester introduction to number theory: Divisibility theory, primes and their distribution, theory of congruences, Fermat?s Little Theorem, number theoretic functions, Euler?s Phi-function and Euler?s Theorem, primitive roots, quadratic reciprocity, non-linear Diophantine equations, other topics if time permits.

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Math 4388 History of Mathematics (Section# 19287)

Time:	Online course
Instructor:	S. Ji
Prerequisites:	Math 3333 Intermediate Analysis, or content of instructor
Text(s):	Text Lecture notes provided. No textbook is required. Reference: Victor Katz, A History of Mathematics: An Introduction, 3rd (or 2nd Ed.), Addison-Wesley, 2009 (or 1998).

Description: 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 Blackboard Vista, visit http://www.uh.edu/webct/ for information on obtaining ID and password.

The course will be based on my notes.

In each week, three chapters of my notes will be posted in Blackboard Learn. Weekly homework and reading assignment will be posted in Blackboard Learn, including essay assignment.

In each week, turn all your homework once by Monday morning through Blackboard Learn

All homework, essays or exam paper, handwriting or typed, should be turned into PDF files and be submitted through Blackboard Learn

There is one open-notes-on-campus final exam in form of multiple choice. This exam will take place on December 7, Saturday, 1:00-4:00 pm, (the last of class of the fall semester), and location of classroom will be announced late).

Grading: 35% homework, 50% projects, 15% Final exam.

This course will be counted toward major or minor requirements in mathematics.

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Math 4389 Survey of Undergraduate Mathematics (Section# 17436)

Time: Online course
Instructor: C. Peters
Prerequisites:
Text(s):
Description:

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GRADUATE ONLINE COURSES

Math 5331 Linear algebra with applications (Section# 18077)

Time: Arrange (online course)

Instructor: K. Kaiser
Prerequisites:
Text(s):
Description:

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Math 5333 Analysis (Section# 20155)

Time: Arrange (online course)
Instructor: G. Egten
Prerequisites:
Text(s):
Description:

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Math 5385 Statistics (Section# 16546)

Time: Arrange (online course)
Instructor: C. Peters
Prerequisites:
Text(s):
Description:

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Math 5347 Technology in Mathematical Classes (Section# 25698)

Time: Arrange (online course)
Instructor: A. Torok
Prerequisites: Acceptance into the MAM program; post bachelor standing
Text(s): No textbook is required. Material will be available on the web.
The software that will be discussed include Mathematica, Octave (the free version of Matlab) and Geometer's Sketchpad. Instructions about installing them will be posted in advance: see the course web-page, under Teaching at www.math.uh.edu/~torok.
Description: The purpose of the course is to introduce software that can be used for teaching mathematics. Descriptions and examples will be posted on-line, followed by assignments aimed at classroom applications.

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Math 5397 Scientific computing with Excell (Section# 21953)

Time: Arrange (online course)
Instructor: J. Morgan
Prerequisites:
Text(s):
Description:

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GRADUATE COURSES

Math 6302 Modern Algebra (Section# 15589)

Time:	MoWe 1:00PM - 2:30PM - Room: CBB 214
Instructor:	G. Heier
Prerequisites:	Graduate standing or consent of instructor.
Text(s):	"Abstract Algebra" by David Dummit and Richard Foote, 3rd Edition
Description:	The course covers topics from the theory of groups, rings, fields, and modules.

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Math 6308 Advanced Linear Algebra I (Section# 16544)

Time:	TuTh 11:30AM - 1:00PM - Room: F 154
Instructor:	Z. Kilpatrick
Prerequisites:	MATH 2331 and a minimum of three semester hours of 3000-level mathematics.
Text(s):	Linear Algebra and Its Applications by Peter D. Lax, 2nd edition, 2007.
Description:	Linear systems of equations, matrices, determinants, vector spaces and linear transformations, eigenvalues and eigenvectors, spectral theory, matrix inequalities, linear mappings, applications including kinematics.
Remark:	There is a limitation for counting graduate credits for Math 6308, 6309, 6312, or 6313. For detailed information, see Masters Degree Options.

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Math 6308 Advanced Linear Algebra I (Section# 18076)

Time:	MoWe 4:00PM - 5:30PM - Room: F 154
Instructor:	V. Climenhaga
Prerequisites:	MATH 2331 and a minimum of three semester hours of 3000-level mathematics.
Text(s):	Linear Algebra and Its Applications by Peter D. Lax, 2nd edition, 2007.
Description:	Linear systems of equations, matrices, determinants, vector spaces and linear transformations, eigenvalues and eigenvectors, spectral theory, matrix inequalities, linear mappings, applications including kinematics.
Remark:	This course will be taught in classroom and also can be taken as an online course. There is a limitation for counting graduate credits for Math 6308, 6309, 6312, or 6313. For detailed information, see Masters Degree Options.

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Math 6312 Introduction to Real Analysis (Section# 16545)

Time:	TuTh 10:00AM - 11:30AM - Room: GAR 201
Instructor:	Bodmann
Prerequisites:	Math 3333
Text(s):	Maxwell Rosenlicht, Introduction to Analysis, Dover, 1968 and supplementary notes.

Description:	This first course in the sequence Math 4331-4332 provides a solid introduction to deeper properties of the real numbers, continuous functions, and differentiability 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: Metric spaces, open and closed sets, compact and connected sets, convergence of sequences, Cauchy sequences and completeness, properties of continuous functions, contraction mapping principle, countable and uncountable sets, Riemann-Stieltjes integration.
Remark:	There is a limitation for counting graduate credits for Math 6308, 6309, 6312, or 6313. For detailed information, see Masters Degree Options.

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Math 6320 Theory of Functions of a Real Variable (Section# 15622)

Time:	MoWeFr 12:00PM - 1:00PM - Room: SEC 203
Instructor:	D. Blecher
Prerequisites:	An undergraduate real analysis sequence (Math 4331, 4332) or equivalent, or consent of instructor. A little topology and metric spaces would be useful.
Text(s):	Lebesgue Integration on Euclidean Spaces, Frank Jones, Jones & Bartlett. However I will be distributing the class notes and they are very complete. Recommended reading: - G.B. Folland, Real Analysis: Modern Techniques and Their Applications (Pure and Applied Mathematics: A Wiley-Interscience Series of Texts, Monographs and Tracts). - Real Analysis, H.L. Royden, (3rd Edition), Prentice Hall. Real and Complex Analysis, W. Rudin, McGraw Hill. Measure Theory, D. L. Cohn, Birkhauser.
Description:	This is the first semester of a 2 semester sequence. This semester we will be developing the basic principles of measure and integration. This body of knowledge is essential to most parts of mathematics (in particular to analysis and probability) and falls within the category of "What every graduate student has to know". I will slim down some of the material from the last time I taught this, since it was too much. The one test and the final exam will be based on the notes given in class, and on the homework. After each chapter we may try (it is often impossible because of students hours) schedule a problem solving workshop, based on the homework assigned for that chapter. The most important part of your task as a graduate student in this course is simply to reread the class notes making sure you understand everything. Please ask me about anything you don't follow. The second most important part of your task is to do as many as possible of the assigned homework. Final grade is approximately based on a total score of 400 points consisting of homework (100 points), a semester test (100 points), and a final exam (200 points). The syllabus for the first semester will cover some but not all of the following topics: Measures. Measurable functions. Integration. Convergence of sequences of functions. The Lp spaces. Signed and complex measures. Product measures and Fubini's theorem. Differentiation and integration.

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Math 6322 Theory of Functions of a Complex Variable (Section# 21954)

Time:	MoWeFr 9:00AM - 10:00AM - Room: AH 301
Instructor:	S. Ji
Prerequisites:	Math 3333 or consent of instructor.
Text(s):	No textbook required. Lecture notes provided.

Description:	This course is an introduction to complex analysis. This two semester course will cover the theory of holomorphic functions, residue theorem, harmonic and subharmonic functions, Schwarz's lemma, Riemann mapping theorem, Casorati-Weterstrass theorem, infinite product, Weierstrass' (factorization) theorem, little and big Picard Theorems and compact Riemann surfaces theory.

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Math 6326 Partial Differential Equations (Section# 21955)

Time:	TuTh 11:30AM - 1:00PM - Room: SEC 203
Instructor:	Y. Gorb
Prerequisites:	MATH 4331 or consent of the instructor. Knowledge of Hilbertspaces theory and Lebesgue integration theory is needed, as well as someexperience with the analysis and/or simulation of differential equations.
Text(s):	L.C. Evans, Partial Differential Equations, AMS, 2010.
Description:	This course treats topics related to the theory of partialdifferential equations (PDEs). In the first semester we will mostly focus onbasic examples of PDEs, arising in continuum mechanics, electromagnetism,complex analysis and other areas, and attempt to develop a number of tools fortheir solution. Then the relevant Hilbert-Sobolev spaces will be described withsome of properties proved. This to be used in subsequent discussion of thebasic results for theory of second order linear problems of elliptic andparabolic type in bounded regions.
Remark:	This course will be taught in classroom and also can be taken as an online course.

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Math 6342 Topology (Section# 15623)

Time:	MoWeFr 10:00AM - 11:00AM - Room: AH 301
Instructor:	M. Tomforde
Prerequisites:	Math 4331 or consent of instructor
Text(s):	Topology (2nd Edition) James Munkres (Author) ISBN-10: 0131816292 ISBN-13: 978-0131816299
Description:	We will cover the basics of point-set topology. Topics include: Topological Spaces and Continuous Functions. Connectedness and Compactness. Countability and Separation Axioms. The Tychonoff Theorem. Metrization Theorems and paracompactness. Complete Metric Spaces and Function Spaces. Baire Spaces and Dimension Theory.

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Math 6360 Applicable Analysis (Section# 16517)

Time:	TuTh 4:00PM - 5:30PM - Room: F 162
Instructor:	G. Auchmuty
Prerequisites:	Undergraduate Mathematical Analysis (Math 4331) or equivalent. Students should know the basic definitions and results of metric space topology, matrices and finite dimensional linear algebra.
Text(s):	Hunter and Nachtergaele, Applicable Analysis, World Scientific Publishing
Description:	This course treats topics related to the solvability of various types of equations, and also of optimization and variational problems. The first half of the semester will concentrate on introductory material about norms, Banach and Hilbert spaces. This will be used to obtain conditions for the solvability of linear equations, including the Fredholm alternative. The second half of the course will cover the contraction mapping theorem and its use to provevarious results about nonlinear equations. These include the finite dimensional implicit and inverse function theorems and the existence of solutions of initial value problems for ordinary differential equations and of integral equations.

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Math 6366 Optimization and Variational Methods (Section# 15624)

Time:	TuTh 1:00PM - 2:30PM - Room: AH 301
Instructor:	J. He
Prerequisites:	Graduate standing or consent of the instructor. Students are expected to have a good grounding in basic real analysis and linear algebra.
Text(s):	Stephen Boyd and Lieven Vandenberghe, Convex Optimization, Cambridge University Press, 2004 (available on the web at http://www.stanford.edu/~boyd/books.html)
Description:	The focus is on key topics in optimization that are connected through the themes of convexity, Lagrange multipliers, and duality. The aim is to develop an analytical treatment of finite dimensional constrained optimization, duality, and saddle point theory, using a few of unifying principles that can be easily visualized and readily understood. The course is divided into three parts that deal with convex analysis, optimality conditions and duality, computational techniques. In Part I, the mathematical theory of convex sets and functions is developed, which allows an intuitive, geometrical approach to the subject of duality and saddle point theory. This theory is developed in detail in Part II and in parallel with other convex optimization topics. In Part III, a comprehensive and up-to-date description of the most effective algorithms is given along with convergence analysis.
Remark:	This course will be taught in classroom and also can be taken as an online course. Note: This is the first part of a two semester course sequence. The second part of this sequence will not have an online version (meeting in classroom only).

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Math 6370 Numerical Analysis (Section# 15625)

Time:	TuTh 5:30PM - 7:00PM - Room: SEC 202
Instructor:	M. Olshanskii
Prerequisites:	Calculus, Linear Algebra, ability to do computer assignments in one of FORTRAN, C, Pascal, Matlab, etc.
Text(s):	A. Quarteroni, R. Sacco, F. Saleri, Numerical Mathematics, 2nd edition, Texts in Applied Mathematics, V.37, Springer, 2010.
Description:	The course introduces to the methods of scientific computing and their application in analysis, linear algebra, approximation theory, optimization and differential equations. The purpose of the course is to provide mathematical foundations of numerical methods, analyze their basic properties (stability, accuracy, computational complexity) and to discuss performance of particular algorithms. This first part of the two-semester course spans over the following topics: (i) Principles of Numerical Mathematics (Numerical well-posedness, condition number of a problem, numerical stability, complexity); (ii) Direct methods for solving linear algebraic systems; (iii) Iterative methods for solving linear algebraic systems; (iv) numerical methods for solving eigenvalue problems; (v) non-linear equations and systems, optimization.

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Math 6374 Numerical Partial Differential Equations (Section# 21956)

Time:	MoWeFr 11:00AM - 12:00PM - Room: F 162
Instructor:	R. Hoppe
Prerequisites:	Calculus, Linear Algebra, Numerical Analysis
Text(s):	S. Larsson and V. Thomee; Partial Differential Equations with Numerical Methods. Springer, Berlin-Heidelberg-New York, 2004

Description:	The course provides an introduction to the development, analysis, and implementation of finite difference and finite element methods for partial differential equations: 1. Foundations of the theory of PDEs 1.1 Classification and characteristics 1.2 Sobolev spaces 2. Numerical methods for elliptic PDEs 2.1 Finite difference methods 2.2 Finite element methods 2.3 Other methods 3. Numerical methods for parabolic PDEs 3.1 Finite difference methods 3.2 Finite element methods 3.3 Other methods 4. Numerical methods for hyperbolic PDEs 4.1 Numerical methods for systems of conservation laws 4.2 Finite difference and finite element methods for the wave equation 4.3 Other methods

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Math 6382 Probability Models and Mathematical Statistics (Section# 15626)

Time:	MoWe 1:00PM - 2:30PM - Room: CBB 122
Instructor:	K. Josic
Prerequisites:	an undergraduate course in probability and linear algebra
Text(s):	Allan Gut: "An intermediate course in probability" Jeffrey Rosenthal: "A first look at rigorous probability"
Description:	This is an introductory graduate course on probability and statistics. Emphasis will be placed on a thorough understanding of the basic concepts as well as developing problem solving skills. Topics covered include: combinatorial analysis, independence and the Markov property, Markov chains, the major discrete and continuous distributions, joint distributions and conditional proba- bility, modes of convergence. These notions will be examined through examples and applications. Computers: There will be a few optional problems which will require a numerical equation solver. You may use Matlab, Mathematica, or any other program you are comfortable with. Homework: There will be 7-8 homework sets during the semester. Each homework set will be due two weeks after it was assigned. You are free to work together on the homework sets, however the work you turn in must be your own. Exams: There will be one midterm and and a final exam.

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Math 6384 Discrete -Time Models in Finance (Section# 15627)

Time: TuTh 4:00PM - 5:30PM - Room: AH 301

Instructor: E. Kao

Prerequisites: Graduate Standing

Text(s): Introduction to Mathematical Finance: Discrete-Time Models, by Stanley R. Pliska, Blackwell, 1997.

Description:

This course is an introduction to discrete-time models in finance.

We start with single-period securities markets and discuss arbitrage, risk-neutral probabilities, complete and incomplete markets. These ideas are then extended to the multiperiod settings. Valuation of options, futures, and other derivatives on equities, currencies, commodities, and fixed-income securities will be covered under discrete-time paradigms. The use of binomial trees and the notion of Arrow-Debreu securities will be explored.

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Math 6395 Stochastic Differential Equations (Section# 21957)

Time: MoWe 4:00PM - 5:30PM - Room: SEC 203

Instructor: A. Torok

Prerequisites: graduate (or advanced undergraduate) standing

Text(s): We will begin with the notes of L. C. Evans (UC Berkeley), available on his web-page. Additional material will be handed out or placed on reserve in the library during the course.

Description:

Stochastic differential equations arise when some randomness is allowed in the coefficients of a differential equation. They have many applications, including mathematical biology, theory of partial differential equations, differential geometry and mathematical finance.

This is an introduction to the theory and applications of stochastic differential equations. A knowledge of measure theory is strongly recommended but not required. We begin by reviewing measure theory, probability spaces, random variables and stochastic processes. We discuss Brownian motion and its properties, then introduce the Ito integral and relevant aspects of martingale theory. We formulate and solve stochastic differential equations, including numerical schemes. Applications will include mathematical finance (arbitrage and option pricing) and connections to PDE's.

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Math 6395 Frames, wavelets and sparse representations (Section# 21958)

Time: TuTh 2:30PM - 4:00PM - Room: AH 301

Instructor: M. Papadakis

Prerequisites: Advanced linear algebra and advanced mathematical analysis (MATH 4377 and/or 4355 and/or 4331-4332). Students who have attended the graduate real analysis are fully prepared for this course. Those who lack some of the basic introduction to the Fourier transform will have to watch a few extra online videos on the topic in order to catch up.

Text(s): A Basis Theory Primer by Christopher Heil, book series ANHA, published by Birkhauser. This book can help as a background textbook for Fourier transforms as well. We will use some articles on Shearlets by D. Labate and co-workers and a review article by E. Candes on Sparse representations and the Restricted Isometry Property published in SIAM Review.

THIS IS AN ONLINE COURSE. The face-to-face classroom meeting will be held only once every week in order to discuss problems and answer questions on the material. This course is not designed only for mathematics graduate students. It is open and suitable for students from other disciplines but with a strong background in mathematics. NON-MATHEMATICS STUDENTS need to contact the instructor before enrolling in this course. THE COURSE IS DELIVERED VIA BLACKBOARD.

Description: We begin with some prerequisites on Hilbert spaces and bounded linear operators. Unconditional bases and Frames in Hilbert spaces, Harmonic and uniform frames, Frames of translates, Gabor frames and the Short Time Fourier Transform. Wavelet frames and Multiresolution Analysis, the Shannon Multiresolution Analysis and the Sampling theorem. Scaling functions and wavelets arising from scaling functions; examples: Daubechies orthonormal wavelets and spline wavelets. The construction of affine wavelet frames by means of the extension principles. Fast wavelet algorithms. Directional representations and shearlets, isotropic multiresolution analysis and isotropic wavelets. Sparse representations and the Restricted Isometry Property, K-SVD and the concept of Dictionary learning. There are no exams, only homework problems both theoretical or applied. To pass the course the student must collect a total of 50 points with the highest possible score to be 70.

Remark: This course will be taught in classroom and also can be taken as an online course.

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Math 6395 Hyperbolic conservation law and numerical methods (Section# 21959)

Time: MoWe 4:00PM - 5:30PM - Room: AH 202

Instructor: J. Qiu

Prerequisites: Differential equations, linear algebra and experience of computer programming. Graduate standing or consent of the instructor.

Text(s): "Numerical methods for conservation laws" by Randall J. LeVeque

Description: The first part of the course is to introduce mathematical theory for hyperbolic conservation laws that arise in many applications such as traffic flow, gas dynamics and fluid dynamics. The second part of the course is on advanced numerical methods for solving hyperbolic systems.

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Math 6397 An Introduction to Reproducing kernel Hilbert Spaces (Section# 21960)

Time: MoWeFr 12:00PM - 1:00PM - Room: SEC 202

Instructor: V. Paulsen

Prerequisites: Basic properties of Hilbert space, Math 6321 or Math 6360 will suffice.

Text(s): Course Notes will be distributed

Description: Reproducing kernel Hilbert spaces are spaces of actual functions, not measurable equivalence classes as in the case of L^2. They play an important role in many areas of mathematics, including statistics, machine learning and integral operators. In this course we will first study their general structure theoryand then use this theory to gain better insight into the applications mentioned above.

Among the topics we will cover are: Aronszajn's theory, Cholesky's algorithm and Schur complements, positive and negative definite functions, least-squares optimization, hyperplane separation, the representer theorem, Schoenberg's characterization of metric spaces that embed in Hilbert space, infinitely divisible kernels, and Mercer's theorem on integral operators with continuous kernels.

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Math 6397 Riemannian geometry (Section# 21961)

Time: TuTh 10:00AM - 11:30AM - Room: F 154

Instructor: M. Ru

Prerequisites: Graduate standing or under-graduates who took Math. 4350-4351.

Text(s): Riemannian geometry by S. Gallot, D. Hulin and J. Lafontaine, Springer, 2004. I will also provide my own notes.

Description:	Topics include: Differentiable Manifolds, tangent space, tangent bundle, Riemannian metric, connections, curvatures, geodesics, Jacobi fields, comparison theorems, harmonic forms and Hodge theory.

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Math 6397 Dynamical System (Section# 21962)

Time:	TuTh 2:30PM - 4:00PM - Room: SEC 203
Instructor:	W. Ott
Prerequisites:	
Text(s):	
Description:	