Term Information

Effective Term	Spring 2026

General Information

Course Bulletin Listing/Subject Area	Mathematics
Fiscal Unit/Academic Org	Mathematics - D0671
College/Academic Group	Arts and Sciences
Level/Career	Graduate, Undergraduate
Course Number/Catalog	5638
Course Title	Topics in Risk Modeling II
Transcript Abbreviation	Top Risk Mod 2
Course Description	Risk Modeling is an important area of Actuarial Science, which is based on statistical or machine learning and the underlying mathematics. Math 5637: Topics in Risk Modeling I offers an introduction to these topics, and Math 5638, as the second course in this sequence, covers more advanced machine learning models with a focus on mathematics and theories.
Semester Credit Hours/Units	Fixed: 3

Offering Information

Length Of Course	14 Week, 12 Week, 8 Week, 6 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites	Prereq: 2568 (or equivalent), STAT 4202 and 5637; or department permission.
Exclusions	
Electronically Enforced	Yes

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	27.0101
Subsidy Level	Doctoral Course
Intended Rank	Junior, Senior, Masters, Doctoral

Requirement/Elective Designation

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- Understand the mathematical concepts and results on which statistical or machine learning is based.
- Use modern machine learning methods for modeling cross-sectional and sequential data
- Identify the applications of the introduced models in solving real-world finance problems
- Implementing basic machine learning models in Python for simple tasks

Content Topic List

- Introduction to ML with cross-sectional data
- Basics of Python programming
- Probabilistic modeling, Bayesian regression, and Gaussian processes
- Feedforward Neural Networks
- Sequential modeling and classic time series models
- Fitting time series models and making predictions
- Probabilistic sequential modeling
- Recurrent Neural Networks
- Gated Recurrent Units
- Convolutional Neural Networks and Autoencoders
- Reinforcement Learning Part 1

Sought Concurrence

No

Attachments

- 5638 syllabus.docx: Syllabus

  (Syllabus. Owner: Husen,William J)

- Curriculum_map_actsci_03222025.docx: Curriculum map Act Sci

  (Other Supporting Documentation. Owner: Husen,William J)

- Curriculum_map_math_03222025.docx: Curriculum map Math

  (Other Supporting Documentation. Owner: Husen,William J)

Comments

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Husen,William J	03/24/2025 08:50 AM	Submitted for Approval
Approved	Husen,William J	03/24/2025 08:51 AM	Unit Approval
Approved	Vankeerbergen,Bernadette Chantal	04/02/2025 09:30 AM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Hilty,Michael Neff,Jennifer Vankeerbergen,Bernadette Chantal Steele,Rachel Lea	04/02/2025 09:30 AM	ASCCAO Approval

Math 5638: Topics in Risk Modeling II

DESCRIPTION

Risk Modeling is an important area of Actuarial Science, which is based on statistical or machine learning and the underlying mathematics. Math 5637: Topics in Risk Modeling I offers an introduction to these topics, and Math 5638, as the second course in this sequence, covers more advanced machine learning models with a focus on mathematics and theories. This course also briefly demonstrates the implementations of these models in Python and their applications in Actuarial Science and Finance.

COURSE OBJECTIVES/LEARNING OUTCOMES

Upon successful completion of the course, students will be able to

- Understand the mathematical concepts and results on which statistical or machine learning is based.
- Use modern machine learning methods for modeling cross-sectional and sequential data
- Identify the applications of the introduced models in solving real-world finance problems
- Implementing basic machine learning models in Python for simple tasks

CLASS FORMAT

Lecture – 3 hours per week

PREREQUISITE

Linear algebra (Math 2568 or equivalent), probability (Math 4530 or Stat 4201 or equivalent), statistics (Stat 4202 or equivalent), and Math 5637; or by department permission.

TEXTS

Class notes will be distributed. The following are recommended textbooks.

- Machine Learning in Finance: From Theory to Practice by Matthew F. Dixon, Igor Halperin, Paul Bilokon (Book PDF available via OSU Library)
- Financial Data Analytics with Machine Learning, Optimization and Statistics by Sam Chen, Ka Chun Cheung, Phillip Yam, Kaiser Fan

HOMEWORK AND EXAMS

There will be

- Five homework assignments
- Three programming assignments (Labs)
- Two midterm exams
- Final exam

EXPECTED WORKLOAD

students will be expected to be working on homework for an approximate total of 6 hours per week.

GRADE

The course grade will be based on

- Homework, 20%
- Labs, 20%
- Two midterm exams, 40%
- Final exam, 20%

Course grade will be determined by the total percentage obtained, roughly as 90–100 for an A, 80–89 for a B, 70–79 for a C, and 60–69 for a D.

SCHEDULE

A tentative weekly schedule is attached. This schedule and the material covered may be changed without notice. It is the students' responsibility to keep track of these changes. Changes may be announced in class verbally, through Carmen, or through email.

ACADEMIC MISCONDUCT

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-48.7). For additional information, see the Code of Student Conduct at http://studentaffairs.osu.edu/csc/ .

DISABILITY SERVICES STATEMENT

The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

If you are ill and need to miss class, including if you are staying home and away from others while experiencing symptoms of a viral infection or fever, please let me know immediately. In cases where illness interacts with an underlying medical condition, please consult with Student Life Disability Services to request reasonable accommodations. You can connect with them at slds@osu.edu; 614-292-3307; or slds.osu.edu.

RELIGIOUS ACCOMMODATION

Ohio State has had a longstanding practice of making reasonable academic accommodations for students' religious beliefs and practices in accordance with applicable law. In 2023, Ohio State updated its practice to align with new state legislation. Under this new provision, students must be in early communication with their instructors regarding any known accommodation requests for religious beliefs and practices, providing notice of specific dates for which they request alternative accommodations within 14 days after the first instructional day of the course. Instructors in turn shall not question the sincerity of a student's religious or spiritual belief system in reviewing such requests and shall keep requests for accommodations confidential.

With sufficient notice, instructors will provide students with reasonable alternative accommodations with regard to examinations and other academic requirements with respect to students' sincerely held religious beliefs and practices by allowing up to three absences each semester for the student to attend or participate in religious activities. Examples of religious accommodations can include, but are not limited to, rescheduling an exam, altering the time of a student's presentation, allowing make-up assignments to substitute for missed class work, or flexibility in due dates or research responsibilities. If concerns arise about a requested accommodation, instructors are to consult their tenure initiating unit head for

assistance.

A student's request for time off shall be provided if the student's sincerely held religious belief or practice severely affects the student's ability to take an exam or meet an academic requirement and the student has notified their instructor, in writing during the first 14 days after the course begins, of the date of each absence. Although students are required to provide notice within the first 14 days after a course begins, instructors are strongly encouraged to work with the student to provide a reasonable accommodation if a request is made outside the notice period. A student may not be penalized for an absence approved under this policy.

If students have questions or disputes related to academic accommodations, they should contact their course instructor, and then their department or college office. For questions or to report discrimination or harassment based on religion, individuals should contact the Office of Institutional Equity. (Policy: Religious Holidays, Holy Days and Observances)

Class Schedule (Tentative):

Week 1	Introduction to ML with cross-sectional data
Week 2	Basics of Python programming
Week 3	Probabilistic modeling, Bayesian regression, and Gaussian processes
Week 4	Feedforward Neural Networks Part 1
Week 5	Feedforward Neural Networks Part 2
Week 6	Feedforward Neural Networks Part 3
Week 7	Sequential modeling and classic time series models
Week 8	Fitting time series models and making predictions
Week 9	Probabilistic sequential modeling
Week 10	Recurrent Neural Networks
Week 11	Gated Recurrent Units
Week 12	Convolutional Neural Networks and Autoencoders
Week 13	Reinforcement Learning Part 1
Week 14	Reinforcement Learning Part 2

Actuarial Science BS/BA Curriculum Map					
Goal 1	**To supply a strong general background in mathematics, statistics, and relevant concepts from the insurance industry**				
Goal 2	**To prepare students to take some of the national actuarial examinations administered by the Society of Actuaries and the Casualty Actuarial Society**				
Course	**Goal 1**	**Goal 2**			
Math 1151	Beginning	Beginning			
Math 1152	Beginning	Beginning			
ACCTMIS 2000	Beginning				
Econ 2001.01	Beginning				
Econ 2002.01	Beginning				
CSE 1222	Beginning	Intermediate			
CSE 1223	Beginning	Intermediate			
CSE 2111	Beginning	Intermediate			
Comm 2110	Beginning				
Comm 2131	Beginning				
Comm 2367	Beginning				
BusFin 3120	Intermediate	Beginning			
English 3304	Beginning				
Math 2153	Intermediate	Beginning			
Math 2568	Intermediate	Beginning			
Math 3588	Intermediate	Advanced			
Math 3618	Intermediate	Advanced			
Math 4530	Advanced	Advanced			
Stat 4201	Advanced	Advanced			
Math 5632	Advanced	Advanced			
Stat 4202	Advanced	Advanced			
Math 5571	Advanced	Advanced			
Math 5630	Advanced	Advanced			
Math 5631	Advanced	Advanced			
Math 5633	Advanced	Advanced			
Math 5634	Advanced	Advanced			
Math 5635	Advanced	Advanced			
Math 5636	Advanced	Advanced			
Math 5637	Advanced	Advanced			
Math 5638	**Advanced**	**Advanced**			

Math - BS/BA Curriculum Map					
Goal 1	**Learn conceptual frameworks needed to study higher mathematics, including an introduction to mathematical reasoning and an understanding of how to read and write proofs.**				
Goal 2	**Aquire basic mastery of core areas of mathematics including calculus, analysis and algebra.**				
Goal 3	**Develop powerful mathematical problem solving skills.**				
Goal 4	**Learn to communicate mathematical understanding effectively.**				
Goal 5	**Become proficient in chosen tracks within the major.**				
Course	**Goal 1**	**Goal 2**	**Goal 3**	**Goal 4**	**Goal 5**
AcctMIS 2000			Beginning		Intermediate
Biochem 4511					Advanced
Biology 1113			Beginning		Intermediate
Biology 1114			Beginning		Intermediate
Biology 3401					Intermediate
BusFin 3120			Intermediate	Intermediate	Advanced
BusFin 3220			Intermediate	Intermediate	Advanced
Chem 1210			Beginning		Intermediate
Chem 1220			Beginning		Intermediate
Chem 2210					Advanced
Chem 2510					Advanced
Chem 4300					Advanced
Chem 4310					Advanced
CSE 1222			Beginning		Intermediate
CSE 1223			Beginning		Intermediate
CSE 2221			Beginning	Beginning	
CSE 2111			Beginning		Intermediate
Econ 2001.01			Beginning		Intermediate
Econ 2002.01			Beginning		Intermediate
EEOB 3310					Advanced
EEOB 3420					Advanced
EEOB 4520					Advanced
Math 1151	Beginning	Beginning	Beginning		
Math 1152	Beginning	Beginning	Beginning		
Math 1181H	Intermediate	Intermediate	Beginning		
Math 1295				Intermediate	Beginning
Math 2153	Intermediate	Intermediate	Beginning		

Math 2182H	Intermediate	Intermediate	Beginning		
Math 2255	Beginning	Intermediate	Intermediate	Beginning	
Math 2568	Beginning	Beginning	Beginning		Beginning
Math 2568H	Intermediate	Beginning	Intermediate	Beginning	Beginning
Math 3345	Advanced	Advanced	Intermediate	Intermediate	Intermediate
Math 3345H	Advanced	Advanced	Intermediate	Intermediate	Intermediate
Math 3350				Intermediate	Beginning
Math 3589			Intermediate	Intermediate	Advanced
Math 3607			Intermediate	Intermediate	Advanced
Math 3618			Intermediate	Advanced	Advanced
Math 4181H	Advanced	Advanced	Advanced	Advanced	Advanced
Math 4182H	Advanced	Advanced	Advanced	Advanced	Advanced
Math 4345	Advanced	Advanced	Advanced	Intermediate	Advanced
Math 4350			Intermediate	Advanced	Advanced
Math 4504	Advanced	Intermediate	Intermediate	Advanced	Advanced
Math 4507	Advanced	Intermediate	Intermediate	Advanced	Advanced
Math 4512	Intermediate		Intermediate	Intermediate	Intermediate
Math 4530	Intermediate	Beginning	Intermediate	Intermediate	Intermediate
Math 4547	Advanced	Advanced	Intermediate	Advanced	Beginning
Math 4548	Advanced	Advanced	Intermediate	Advanced	Beginning
Math 4551	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
Math 4552	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
Math 4556			Intermediate	Advanced	Advanced
Math 4557	Intermediate		Intermediate	Intermediate	Intermediate
Math 4570	Intermediate	Intermediate	Advanced	Intermediate	Intermediate
Math 4573	Advanced	Intermediate	Intermediate	Intermediate	Intermediate
Math 4575	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
Math 4578	Intermediate	Intermediate	Intermediate	Intermediate	Advanced
Math 4580	Advanced	Advanced	Intermediate	Advanced	Beginning
Math 4581	Advanced	Advanced	Intermediate	Advanced	Beginning
Math 5101	Beginning	Advanced	Intermediate		Intermediate
Math 5102	Beginning	Advanced	Intermediate		Intermediate
Math 5421	Beginning	Beginning	Intermediate	Beginning	Advanced
Math 5451	Beginning	Beginning	Intermediate	Beginning	Advanced

Math 5520H	Advanced	Advanced	Advanced	Advanced	Intermediate
Math 5522H	Advanced	Advanced	Advanced	Advanced	Intermediate
Math 5529H	Advanced	Advanced	Advanced	Advanced	Intermediate
Math 5530H	Advanced	Advanced	Advanced	Advanced	Intermediate
Math 5540H	Advanced	Advanced	Advanced	Advanced	Advanced
Math 5540H	Advanced	Advanced	Advanced	Intermediate	Beginning
Math 5571	Advanced	Advanced	Advanced	Intermediate	Intermediate
Math 5576H	Advanced	Advanced	Advanced	Advanced	Advanced
Math 5590H	Advanced	Advanced	Advanced	Advanced	Advanced
Math 5591H	Advanced	Advanced	Advanced	Advanced	Advanced
Math 5632			Intermediate	Advanced	Advanced
Math 5635			Intermediate	Advanced	Advanced
Math 5636			Intermediate	Advanced	Advanced
Math 5637			Intermediate	Advanced	Advanced
Math 5638			**Intermediate**	**Advanced**	**Advanced**
Math 5660					Intermediate
Math 5756			Beginning	Intermediate	Intermediate
Math 5757			Beginning	Intermediate	Intermediate
MolGen 4500					Advanced
MolGen 5601					Advanced
Physics 1250			Beginning		Intermediate
Physics 1251			Beginning		Intermediate
Physics 2300					Advanced
Physics 2301					Advanced
Stat 4201	Intermediate	Beginning	Intermediate	Intermediate	Intermediate
Stat 4202	Intermediate		Intermediate		Intermediate