Term Information

Effective Term	Spring 2022

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	5637
Course Title	Topics in Predictive Modeling
Transcript Abbreviation	Topics Pred Mod
Course Description	An introduction to some basic concepts and methods in statistical learning with emphasis on the mathematics behind these concepts and methods.
Semester Credit Hours/Units	Fixed: 3

Offering Information

Length Of Course	14 Week, 7 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	A grade of C- or better in 2568 or 5520H and a grade of C- or better in Stat 4202; or permission of department.
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

- Understanding supervised and unsupervised learning.
- Understanding the lasso, sparse regression, classification and regression trees.
- Understanding busting and support vector machines.

Content Topic List

- Supervised/unsupervised learning, loss function, regression and classification.
- Model Accuracy: training and test error, bias-variance trade-off, KNN.
- Linear Regression: simple and multiple linear regression, hypothesis testing, variable selection, model fit
- Introduction to GLM: general linear regression and link function.
- Classification: logistic regression, linear and quadratic discriminant analysis.
- Resampling: cross-validation, bootstrap.
- Model Selection: variable selection, ridge regression and Lasso, dimension reduc- tion, principal component analysis, partial least squares.
- Nonlinear Regression: polynomial regression, regression splines, smooth splines, generalized additive model.
- Tree Based Methods: decision trees, pruning, classification and regression trees, error rate, bagging, random forests, boosting.
- Neural Networks.
- Support Vector Machines: maximal margin classifier, support vector classifier, kernel functions, support vector machines.
- Introduction to Unsupervised Learning: PCA in unsuperwised learning, K-means and hierarchical clusterings.

Sought Concurrence

No

Attachments

- Math_5637_syllabus.pdf: Syllabus
  (Syllabus. Owner: Husen,William J)
- Curriculum_map_actsci_09102021.docx: Curriculum map - Act Sci
  (Other Supporting Documentation. Owner: Husen,William J)
- Curriculum_map_math_09102021.docx: Curriculum map - Math
  (Other Supporting Documentation. Owner: Husen,William J)

Comments

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Husen,William J	09/17/2021 11:06 AM	Submitted for Approval
Approved	Husen,William J	09/17/2021 11:29 AM	Unit Approval
Approved	Vankeerbergen,Bernadette Chantal	09/20/2021 12:01 PM	College Approval
Pending Approval	Cody,Emily Kathryn Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Hilty,Michael Vankeerbergen,Bernadette Chantal Steele,Rachel Lea	09/20/2021 12:01 PM	ASCCAO Approval

Math 5637 - Topics in Predictive Modeling

- COURSE FORMAT
  Math 5637 is taught in a lecture format and consists of 3 contact hours per week.

- DESCRIPTION
  An introduction to some basic concepts and methods in statistical learning with emphasis on the mathematics behind these concepts and methods.

- COURSE OBJECTIVES
  The objectives of the course include understanding of basic concepts and main methods in statistical learning, such as supervised and unsupervised learning, the lasso and sparse regression, classification and regression trees, and boosting and support vector machines. Several computer labs based on the software package `R` will be assigned to expose students to applications.

- PREREQUISITE
  Linear algebra (Math 2568 or equivalent) and statistics (Stat 4202 or equivalent), or by department permission.

- RECOMMENDED TEXTS
  1. *An Introduction to Statistical Learning* with Applications in `R`
     by Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani
     `https://link-springer-com.proxy.lib.ohio-state.edu/book/10.1007/978-1-4614-7138-7`
  2. *The Elements of Statistical Learning* – Data Mining, Inference, and Prediction
     by Trevor Hastie, Robert Tibshirani, Jerome Friedman
     `https://web.stanford.edu/~hastie/ElemStatLearn/`
  3. *Predictive Modeling Applications in Actuarial Science*
     Volume I: Predictive Modeling Techniques
     Edited by E. Frees, R. Derrig, G. Meyers

  The course will mainly follow 1.

- TOPICS
  - Introduction: supervised/unsupervised learning, loss function, regression and classification
  - Model Accuracy: training and test error, bias-variance trade-off, KNN
  - Linear Regression: simple and multiple linear regression, hypothesis testing, variable selection, model fit
  - Introduction to GLM: general linear regression and link function
  - Classification: logistic regression, linear and quadratic discriminant analysis
  - Resampling: cross-validation, bootstrap,
  - Model Selection: variable selection, ridge regression and Lasso, dimension reduction, principal component analysis, partial least squares

  - Nonlinear Regression: polynomial regression, regression splines, smooth splines, generalized additive model
  - Tree Based Methods: decision trees, pruning, classification and regression trees, error rate, bagging, random forests, boosting
  - Neural Networks
  - Support Vector Machines: maximal margin classifier, support vector classifier, kernel functions, support vector machines
  - Introduction to Unsupervised Learning: PCA in unsuperwised learning, K-means and hierarchical clusterings

- GRADE
  The course grade will be based on
  - Homeworks and labs, 20%
  - Two midterm exams, 50%
  - Final exam, 30%

  Course grade will be determined by the total percentage obtained, roughly as 90–100 for an A, 80–89 for a B, 65–79 for a C, and 50–64 for a D.

- HOMEWORK-LABS
  Homework and lab assignments will be regularly assigned and it is expected that students will spend approximately 6 hours per week preparing for and completing assignments.

- SCHEDULE
  A tentative weekly schedule is attached. This schedule and 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 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

- Disability Services Statement
  The University strives to make all learning experiences as accessible as possible. 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. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Week 1	Introduction to Statistical Learning - Homework 1
Week 2	Model Accuracy, Introduction to `R` - Homework 2
Week 3	Simple and Multiple Linear Regression - Homework 3
Week 4	Considerations in Regression Model - Homework 4 - Lab 1
Week 5	GLM, Logistic Regression - Midterm 1
Week 6	Linear Discriminant Analysis - Homework 5
Week 7	Cross-Validation - Homework 6 - Lab 2
Week 8	Bootstrap - Homework 7
Week 9	Linear Model Selection and Regularization, Principal Component - Homework 8
Week 10	Nonlinear Regression and Splines - Homework 9 - Lab 3
Week 11	General Additive Models, Decision Trees - Midterm 2
Week 12	Support Vector Machines - Homework 10
Week 13	Neural Networks, Unsupervised Learning/PCA - Homework 11
Week 14	K-Means and Hierarchical Clusterings - Homework 12 - Lab 4

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 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 - 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 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 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 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