Math 456 Course Syllabus

Course Title

Math Modeling (Big Data Modeling)

Course Number

Math456-01&02

Instructor, Office, Email

Instructor: Jinguo Lian

Office: LGRT(1028)

E-mail: lian@math.umass.edu

Class Schedule and Location

Section 2 (MWF 12:20 - 1:10pm), Location: LGRT 173

Section 1 (MWF 1:25-2:15pm), Location: LGRT 173

Office hours

MWF: 2:30-3:30 by appointment.

Math456 TAs

TA of math456-01: David Masse, email: dmasse@umass.edu

TA of math456-02: Santiago Neira Lopez, email: sneiralopez@umass.edu

If you have any questions about team essays/projects, homework questions and grades of homework and quizzes on gradescope, you may contact or drop in TA's office hours or make an appointment to meet your section TA through zoom or in-person.

Prerequisites

Math 233, Math 235 and Stats 515. Some familiarity with programming languages is desirable (R studio, Python, etc.). Some familiarity with statistics and probability is desirable.

Recommended materials

Textbook: I will post my lecture notes, you do not need to buy a textbook, but if you want to pass SOA Exam SRM, I recommend that you should buy the following book online,

Statistics for Risk management, 4th or later version by Abraham Weishaus. You can buy it online at https://www.studymanuals.com/Product/Show/453142456

Gradescope: We will use gradescope to grade in-class team quizzes, homework and team essays.

I will synchronize the class roster through the Canvas directly during the first week of the spring semester, you will get a notification from Gradescope to access your account directly.

Description

We learn how to build, use, and critique mathematical models. In modeling, we translate scientific questions into mathematical language, and thereby we aim to explain the scientific phenomena under investigation. Models can be simple or very complex, easy to understand or extremely difficult to analyze. We introduce some classic models from different branches of science that serve as prototypes for all models. Student groups will be formed to investigate a modeling problem themselves, and each group will report its findings to the class in a final presentation. The choice of modeling topics will be largely determined by the interests and background of the enrolled students. Satisfies the Integrative Experience requirement for BA-Math and BS-Math majors.

Learning Objectives

To provide students with an introduction to methods and models for analyzing data. Students will be familiar with regression models (including the generalized linear model), time series models, KNN models, principal components analysis, decision trees, and cluster analysis. Candidates will also be able to apply methods for selecting and validating models. This may be assessed through team quizzes, homework, and team essays.

Team (Teamwork and Team essays)

In the first class, students voluntarily form teams, with no more than 6 people in each team. Each team, the team members elect the team leader and report to me at the end of class. Each student must join a team to do the teamwork. Starting in week 2, I will ask students to sit in groups, you can work together on in-class quizzes and team projects. I encourage that you should actively discuss quiz questions and course projects with your group members, which may help you learn course material better, and be a quick path to completing course projects.

The team leader's responsibility: Normally I will hold a 30-minute lecture; leave 20 minutes for students to do the in-class team quizzes. The team leader should ask your team member to sign the attendance sheet (the team leader **can NOT** replace a member to sign the attendance sheet), organize members to work together to get the solutions and submit the solution pdf file with member's attendance signatures together as a group work to gradescope immediately.

For the team essay, the team leader should use the same process to organize team essays and submit the essays as group work to gradescope before the deadline.

Group leaders, when you submit in-class quizzes and team essays to gradescope, be sure to choose member names who **participated in** the work on gradescope, so that participated members can get credits too. **If some members did not participate in the work, then you should not list their names to gradescope quiz solutions or team essays**.

Course Requirements

Attend classes regularly, sign the group leader's attendance sheet and complete the teamwork.

Complete assigned team essays submit it to gradescope by deadline.

Complete and submit homework to gradescope on time (you may find the deadline of homework on Canvas course, but you should submit solutions to gradescope).

Attend final defenses of team essays in the last two weeks.

Weekly Schedule

The following is meant to give a general idea of which sections are covered in which weeks. Coverage may be different depending on such factors as MWF vs. TuTh schedule, different paces of individual instructors, etc. However, it is expected that all these sections will be covered.

Week	Lecture	Events
1/27	Course Introduction	The semester starts on 1/30, and the first day of classes is Friday 1/31.
2/3	Basic Linear regression, Multiple Linear regression, Standard error	2/5 is the last day to add/drop Hw-1 is due 2/7, 11pm on gradescope
2/10	Linear regression: R^2, t statistics, F statistics	Hw-2 is due 2/14, 11pm on gradescope
2/17	Linear regression: validation, outliers, and influential points, collinear of explanatory variables; VIF	2/17 Mon is Holiday 2/20, Thursday=Mon Hw-3 is due 2/21, 11pm on gradescope Team essay-1 is due 2/19, 11pm on gradescope

2/24	Linear regression: Resampling method, subset selection; shrinkage	Hw-4 is due 2/28, 11pm on gradescope
3/3	Linear regression: dimension reduction; prediction, interpreting regression result	
3/10	generalized linear model: linear exponential family, Link function, binomial response	Hw-5 is due 3/12, 11pm on gradescope Team essay-2 is due 3/12, 11pm on gradescope
3/17		Spring recess
3/24	Generalized linear model: Nominal response, Ordinal response, count response	Hw-6 is due 3/26, 11pm on gradescope Team essay-3 is due 3/28, 11pm on gradescope
3/31	Generalized linear model: Pearson chi-square and deviance of normal; deviance of Bernoulli and penalized loglikelihood tests; Max-scaled R^2 and Pseudo-R^2	4/3 is the last day to drop with W Hw-7 is due 4/2, 11pm on gradescope
4/7	KNN, decision tree, Principal component analysis	Hw-8 is due 4/9, 11pm on gradescope Team essay-4 is due 4/11, 11pm on gradescope
4/14	cluster analysis, Time series: basics, mean and variance	4/18, Friday=Mon Hw-9 is due 4/16, 11pm on gradescope
4/21	white noise and random walks; Time series: auto-regression models; Forecasting models;	4/21, Monday is Holiday Team essay-5 is due 4/22, 11pm on gradescope Hw-10 is due 4/23, 11pm on gradescope
4/28	Final defenses	Team essay-6 is due 5/2, 11pm on gradescope
5/5	Final defenses	Friday, 5/9 is the last class.
5/12	No final exam in this course	Final grade is due at midnight 5/22.

Course information and communication

There is a corresponding Canvas course where you may find printable syllabus, PDF notes and other related course materials. If you have any questions, you may send me an email or schedule an appointment.

Weights of Individual Assignments toward final grade

In-class quizzes (50%): we have an in-class teamwork per class. The team leader will ask each participating member to sign the attendance sheet, then work on the question as a team. At the end of class, the team leader should scan the solution into a pdf file and submit the solution and the attendance sheet together to gradescope as a teamwork. Team leader and members, be sure to justify your answer. Answer without supporting work may receive zero credit. The following is a sample of teamwork solution sheet,

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<div align="center">

Team quiz sample and format

Team quiz date 1/29/25

</div>

Team leader: John Mayers, email: johnm@umass.edu

Note: members, you may contact the team leader via the email if you attend the quiz, but you did not get credit on the quiz, Members, it is your responsibility to sign your name on the solution sheet, if your name is not on the sheet, you should not get credits. If you attended the class but you forgot to sign the sheet, you should contact your team leader immediately. Unless the team leader agrees, you cannot add your name after the class.

Members: Steven Huang (handwritten signature, not typed name)

Lowes Bonstany (handwritten signature, not typed name)

Eric Mcmalon (handwritten signature, not typed name)

Quiz steps and solution:

> **Here is the support work shown below. The signature and the solution must be on the same page, and one page would be enough for both signature and the solution. The team leader can scan the page using your iPhone "notes' to a pdf file, the submit it to gradescope for grading. Answer without support work may receive 0 credit!**

If you don't know how to use your iPhone to scan a file to a pdf file, you may look through the instruction at https://www.macworld.com/article/232686/how-to-scan-documents-and-make-pdfs-using-notes-on-your-iphone-or-ipad.html.

Please submit a scanned PDF file instead of a picture file. Because the content of a picture file is easily affected by background color or light, therefore it is hard to read.

Normally my grader grades teamwork and homework week by week. You may find the grades of homework through gradescope. If you have any questions about the homework and teamwork grades, you may consult my grader by email (cc me a copy).

Team-Essay (essays: 20%+final defenses: 20%=40%): We have six team essays through the semester. It is a team leader's responsibility to assign a part of the work for team members and hand in the essay to Gradscope by the due date. Each team should prepare an in-class essay defense during the last two weeks of the semester, where I will check the following four aspects of the essay: the data description, the math model introduction, and run R code, summarize prediction and conclusion. If there are no questions in each aspect, then the essay is worth full points. You may check the grade on the Gradescope course.

Homework (10%): I will post the homework questions per chapter, you may see the deadline of the chapter homework on canvas course, please mark the question number clearly and scan the solutions into a pdf file, submit the pdf file to gradescope before the deadline. Solutions given without supporting work may receive 0 credit.

Bonus: I encourage students to show group quiz solutions during the in-class teamwork time. If any of the students showed the solution of the teamwork correctly during the class, you may get Bonus (2 points), which will be added to your overall score directly. Each student can show three questions.

Calculator

Any calculator accepted by the Society of Actuaries (SOA) See here for a list. I will use the TI BA II Plus calculator in the course. (TI = Texas Instruments and BA = Business Analyst.) Here is a short note on some of the calculator functions for TI BA II Plus.

Grading Scale

The final score is calculated by adding in-class team quizzes (50%), Homework (10%), Team essays (40%) and Bonus. The letter grade will be assigned by following score intervals.

A = 90 - 100%

A- = 87 - 89.99%

B+ = 83 - 86.99%

B = 79 - 82.99%

B- = 75 -78.99%

C+ = 71 -74.99%

C = 67 - 70.99%

C- = 63 - 66.99%

D+ = 59 - 62.99%

D = 55 - 58.99%

F = 0 - 54.99%

Final Exam

There is NO final exam for this course.

Attendance and other class policies

Attendance: Students should attend the class regularly and join a team to complete the course assignments directly. Because the attendance is related to teamwork, which is 50% of final grading. Unless you can provide official documents for class absence, there is no make-up for team quizzes.

Special Accommodation: The University of Massachusetts Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological, or learning disability on file with Disability Services (DS), you may be eligible for reasonable academic accommodation to help you succeed in this course. If you have a documented disability that requires accommodation, please notify me within the first two weeks of the semester so that we may make appropriate arrangements. For further information, please visit Disability Services (https://www.umass.edu/disability/)

Makeup Policy: For Teamwork/homework/team essays, there is no extension or make-up unless you can provide me with an official document. Team leaders, it is your responsibility to add your member names to teamwork sheet/team essays when you submit the work to gradescope. Members, if you see your name missing on some teamwork/team essays, you should contact your team leader immediately to ask your team leader add the name on if you have participated in the work.

Which case and where to get the official support documents for requesting make-up or an extension.

 (1) If you have an exam (or a class) schedule conflicts with the regular exam, you should log on the Spire page, go to "Student Home" and then to "Evening Exam Conflict". This will allow you to fill out a conflict form and submit it. Then the registrar will email your instructor who needs to provide a makeup exam.

(2) If you have a university travel for university business during the regular exam date, like an athletic competition or academic conference etc., you should ask your supervisor or your coach to write an explanation letter including his/her phone number to your instructor as the official written document. Your instructor may verify the event by phone call.

(3) If you have a religious observance on a regular exam date and CANNOT take the exam, you should write an explanation letter yourself and attach the invitation letter or relevant information as the official document.

(4) If you have a medical reason and CANNOT take the regular exam, you should ask a medical professional's statement including his/her phone number, which indicates that you were unable for medical reasons to take the scheduled exam. If the medical professional's statement is not given before the exam, your instructor may refuse your make-up request.

Homework Extension: There is no extension for homework unless you have special accommodation.

Electronic submission

It is students' responsibility to make sure any electronic submission goes through successfully (uploaded a PDF solution to Gradescope, no blurry images, and the questions and answers match) and check with the instructor or TA that the submission is successful.

Contingency plan

Before the semester, please test the technology that we use. If you have a difficulty to access the UMass Canvas course or zoom, please contact UMass OIT support https://www.umass.edu/it/support. If you have a difficulty to access the Gradescope, please contact Gradscope help at help@gradescope.com.

Help

The best way to get help is to schedule an appointment with my TA or me during my office hours on MWF 2:30-3:30pm.

Incompletes

An Incomplete is possible only if: (1) you had a compelling personal reason, e.g., serious illness; (2) your work has clearly been passing; and (3) there is a good chance you'll complete the course with a passing grade within the allotted time. Thus, **failing work is no reason for an Incomplete.**

Title IX Statement

In accordance with Title IX of the Education Amendments of 1972 that prohibits gender-based discrimination in educational settings that receive federal funds, the University of Massachusetts Amherst is committed to providing a safe learning environment for all students, free from all forms of discrimination, including sexual assault, sexual harassment, domestic violence, dating violence, stalking, and retaliation. This includes interactions in person or online through digital platforms and

social media. Title IX also protects against discrimination on the basis of pregnancy, childbirth, false pregnancy, miscarriage, abortion, or related conditions, including recovery. There are resources here on campus to support you. A summary of the available Title IX resources (confidential and non-confidential) can be found at the following link: https://www.umass.edu/titleix/resources. You do not need to make a formal report to access them. If you need immediate support, you are not alone. Free and confidential support is available 24 hours a day / 7 days a week / 365 days a year at the SASA Hotline 413-545-0800.

Academic Honesty Statement

Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst. Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent (http://www.umass.edu/dean_students/codeofconduct/acadhonesty/).

Reimburse your Exam P/FM/SRM expense.

The department will reimburse the full fee (up to $500) for any of the first three exams that are successfully passed. For detailed information, you may look over the following page.

https://www.math.umass.edu/undergraduate/actuarial-science#Exam%20Fund