COURSE INFORMATION

Instructor: Dr. Peter Howard
E-mail: phoward@tamu.edu
Course Time: Section 930: MWF 1:50 p.m. – 2:40 p.m.; Section 931: MWF 3:00 p.m. – 3:50 p.m.
Course Location: BLOC 148 (both sections)
Office Hours: TR 1:30 p.m. – 3:00 p.m.; T online; R in BLOC 625B
Course webpage: http://www.math.tamu.edu/~phoward/M442.html

COURSE CATALOG DESCRIPTION

The construction of mathematical models from areas such as economics, game theory, integer programming, mathematical biology, and mathematical physics.

COURSE GOAL

The primary goal of the course is to introduce students to both deterministic and probabilistic techniques useful in the development of mathematical descriptions of physical events and processes. The main topics will be linear and nonlinear regression, dimensional analysis, modeling with ordinary differential equation, and discrete and continuous methods of probabilistic modeling. We will work with two software packages, MATLAB for numerical computation and LYX for typesetting reports.

COMMUNICATIONS DESIGNATION

MATH 442, Sections 930 and 931 are designated as *communications* (C) courses. The primary requirements associated with this designation are as follows:

- Require writing and speaking or other forms of oral communication related to the students' major;
- Provide instruction in writing and speaking and feedback that allows for the improvement of major assignments;
- Base a percentage of the final course grade on writing and speaking quality (**at least** 25% for a 4-credit course, 33% for a 3-credit course, and 75% for a 1-credit course);
- Require a minimum of 1250 words of writing and 5 minutes of oral communication;
- Base less than 30% of the writing percentage on collaborative writing.

Additional information about C courses is available in the document *M442 as an oral communications (C) course*, available on the course web site, and at

https://writingcenter.tamu.edu/Students/W-C-Courses

COURSE LEARNING OUTCOMES

Upon successful completion of this course, students will be able to: articulate the major steps associated with using mathematics to model physical events and processes; implement mathematical models in MATLAB; write clear and accurate descriptions of modeling projects; recognize applications for which linear or nonlinear regression is appropriate, and in such cases apply these methods effectively; recognize applications for which dimensional analysis is appropriate, and in such cases apply the method effectively; model dynamical processes with ordinary differential equations; analyze models based on ordinary differential equations in order to obtain productive information about the described dynamical processes; recognize applications for which probabilistic modeling is appropriate; model physical processes with discrete and continuous probability methods.

REQUIRED MATERIALS

TEXTBOOK: No textbook is required for the course. Course materials will be provided through the course web site.

TECHNOLOGY: Students will need to obtain (free) copies of the software packages MATLAB and LyX. For information about obtaining MATLAB, see the document *Accessing MATLAB at Texas A&M University*, available on the course web site. LyX is available at www.lyx.org.

GRADING

HOMEWORK: Individual homework assignments will be made on the first four Fridays of the course, after which projects will be assigned instead. Work will be accepted up to a week late, though five points will be deducted for each class period by which the assignment is late. (A typical assignment will be worth 50 points.) Homework will be posted in Canvas, and can be submitted either in Canvas or in person.

PROJECTS: Three projects will be assigned during the semester, each of which will be roughly two to four weeks in duration. The first project will be individual, the remaining two carried out in groups of two or three students, with groups changing after the second project. Projects will not be accepted late.

GROUP PRESENTATION: As discussed briefly above, students taking a course with the oral communications (C) designation are required to give an oral presentation at least five minutes in length. During the last two or three class periods of the semester, each Project 3 group will give a presentation to the class on a topic of the group's choosing (related to mathematical modeling), and each student in the group will be responsible for at least five minutes of the presentation.

EXAMS: There will be two exams during the semester, a midterm and a final. The midterm will be an evening exam, Wednesday March 9, 7:00 p.m. – 9:00 p.m. (the same for both sections). The final exam time will vary by section as follows:

- Section 930: Monday, May 9, 3:30 p.m. – 5:30 p.m.
- Section 931: Monday, May 9, 10:30 a.m. – 12:30 p.m.

GRADES: Final grades will be determined in the following manner: **individual project:** 10%; **group projects**: 18% each; **homework assignments**: 10%; **group presentation**: 5%; **midterm**: 19%; **final**: 20%. Standard grade ranges will be used: A: 89.5 – 100; B: 79.5 – 89.49; C: 69.5 – 79.49; D: 59.5 – 69.49; F: Below 59.5. Note. The missing percentage point on midterms arises from requirements associated with the C-course designation. For details on the C-course grading requirements, see the document *M442 as an oral communications (C) course*, available on the course web site.

COURSE SCHEDULE

Week of Monday:	Material Covered
Jan. 17	Introduction to MATLAB and LyX. (A&M classes start Tues., Jan. 18.)
Jan. 24	Linear least squares regression. (Mon., Jan. 24 last day for drop/add.)
Jan. 31	Nonlinear least squares regression.
Feb. 7	Dimensional analysis.
Feb. 14	Dimensional analysis. (Project 1 assigned Fri., Feb. 18.)
Feb. 21	Modeling with ODE.
Feb. 28	Analysis of ODE models. (Project 1 due Fri., Mar. 4; Project 2 assigned.)
Mar. 7	Solving ODE in MATLAB. (Midterm exam, Wed., Mar. 9.)
Mar. 14	SPRING BREAK
Mar. 21	Modeling with probability: introduction and counting arguments.
Mar. 28	Modeling with probability: expected value and Bayes' Theorem.
Apr. 4	Introduction to game theory. (Project 2 due Fri., Apr. 8; Project 3 assigned.)
Apr. 11	Game theory: mixed strategies. (Fri., Apr. 15 is a reading day; classes don't meet.)
Apr. 18	Game theory: mixed strategies.
Apr. 25	Begin group presentations.
May 2	Group presentations. (Tues., May 3 is the last day of spring semester classes; students attend Friday classes. Project 3 due Tues., May 3.)

UNIVERSITY POLICIES

COPYRIGHT: All printed handouts and web-materials are protected by US Copyright Laws. No multiple copies can be made without written permission by the instructor.

ATTENDANCE: The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments. Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

MAKEUP WORK: Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor. Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines. Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" (Student Rule 7, Section 7.4.1). "The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" (Student Rule 7, Section 7.4.2). Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

ACADEMIC INTEGRITY: Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case (Section 20.1.2.3, Student Rule 20). You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

"An Aggie does not lie, cheat or steal, or tolerate those who do."

AMERICANS WITH DISABILITIES ACT (ADA): Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact Disability Resources in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu. Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

TITLE IX AND STATEMENT ON LIMITS TO CONFIDENTIALITY: Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking. With the exception of some medical and mental health providers, all university employees (including full and part-time faculty,

staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see University Rule 08.01.01.M1):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, a person who is subjected to the alleged conduct will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need. Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS). Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's Title IX webpage.

MENTAL HEALTH AND WELLNESS: Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in healthy self-care by utilizing the resources and services available from Counseling & Psychological Services (CAPS). Students who need someone to talk to can call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at suicidepreventionlifeline.org.