

MATH 4380 Modeling and Numerical Analysis

The University of Texas at Tyler, Fall 2026

Instructor: Dr. Ivan Ramirez-Zuniga

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Office: RBN 4005

Website: All materials will be posted on Canvas

Time and Place:

- TuTh 2:00 pm - 3:20 pm at HPC 3010.

Office Hours: TuTh 3:30 pm - 5:00 pm , or request an appointment by email (at least one day in advance).

Preferred method of communication: My preferred method of communication is by email.

Textbook: There is no single required textbook for this course. Lecture notes and other course materials will be provided by the instructor.

Additional references include:

- Numerical Analysis, Ninth Edition, by Richard L. Burden and J. Douglas Faires (2010).
- Numerical Methods and Analysis with Mathematical Modeling by William P. Fox and Richard D. West, first edition (2025). The book is available through the University as a free PDF and can also be read online [here](#).
- Mathematical Modeling the Life Sciences Numerical Recipes in Python and MATLAB by N.G. Cogan (2023). The book is available through the University as a free PDF and can also be read online [here](#)
- A Course in Mathematical Biology: Quantitative Modeling with Mathematical and Computational Methods by Gerda de Vries, Thomas Hillen, Mark Lewis, Johannes Müller, and Birgitt Schönfisch (2006).
- A First Course in Mathematical Modeling. Frank R. Giordano, William P. Fox, Steven B. Horton. Cengage Learning (2013).
- A Course in Mathematical Modeling by Douglas D. Mooney Randall J. Swift. Cambridge University Press (1999).
- Mathematical Modeling and Simulation Introduction for Scientists and Engineers. Kai Velten, Dominik M. Schmidt, Katrin Kahlen. Wiley-VCH (2024).

Course description: An introduction to mathematical modeling and numerical analysis with applications in the life sciences and other applied fields. Topics include discrete dynamical systems, numerical solution of nonlinear equations, interpolation, numerical differentiation and integration, numerical methods for ordinary differential equations, sensitivity analysis, and curve fitting. Students will formulate models, implement numerical algorithms, analyze error and stability, and interpret computational results using Python and MATLAB.

Course prerequisites: A grade of C or better in MATH 3380.

Student Learning Outcomes: Upon completion of this course, students should be able to do the following:

1. Formulate mathematical models from descriptions of biological, physical, and other applied systems by identifying relevant variables, parameters, assumptions, and relationships.
2. Select and implement appropriate numerical methods for solving nonlinear equations, interpolation problems, numerical differentiation and integration, optimization problems, and ordinary differential equations.
3. Use Python and MATLAB to implement numerical algorithms, simulate mathematical models, visualize results, and compare computational solutions with analytical or experimental information.
4. Fit mathematical models to data using curve-fitting, least-squares, and parameter-estimation techniques, and assess the quality and limitations of the resulting fit.
5. Interpret numerical and modeling results in the context of the original application, particularly for problems arising in population dynamics, epidemiology, physiology, and other areas of the life sciences.
6. Communicate mathematical modeling and numerical-analysis results clearly through written explanations, mathematical notation, computational figures, and oral presentations.

Grading procedure:

- Midterm Exams (2): 40% (equally weighted)
- Final Exam (cumulative) 20%
- Quizzes 10%
- Projects and Presentations 30%

Grading scale: The grading scale will be no more harsh than

$$A : 90 \leq x \leq 100, \quad B : 80 \leq x < 90, \quad C : 70 \leq x < 80, \quad D : 60 \leq x < 70, \quad F : x < 60.$$

Quizzes: There will be short **quizzes throughout the semester**. Each quiz will be announced during the class meeting immediately preceding it. Quizzes will be based on material covered in lecture and/or assigned exercises. They are intended to assess your understanding of the concepts and methods discussed in class and your ability to apply them independently. Make-up quizzes will not be offered unless the student notifies the professor before the scheduled quiz is missed. If you know that you will have to miss a quiz for a legitimate reason (medical emergency, athletic commitment, religious observance, etc.), you must notify the professor in advance to arrange a make-up quiz. Missed quizzes that are not made up within the permitted time will earn a grade of zero.

Projects and presentations: Throughout the semester, you will be assigned several projects designed to give you opportunities to explore topics related to modeling and numerical analysis in greater depth. Projects may involve developing or analyzing a mathematical model, implementing numerical methods computationally, interpreting numerical results, or studying and presenting material from a book chapter or another source that complements the topics covered in class. Depending on the project, you may be asked to work individually or in small groups and to present your work in class, discuss it during an individual meeting with me, or submit a recorded presentation. More detailed instructions, expectations, and grading criteria will be provided for each project.

Make-up policy: Make-ups for documented absences that are required as part of a UT Tyler obligation (e.g. athletes participating in an event, students participating in a debate contest, etc.) or for religious observation will be granted. **For all make-ups of this type, prior notification of at least one week and documentation are required. Other make-ups are granted only in extreme cases and at the sole discretion of the instructor. Valid documentation, such as a medical note from a health professional (dated within 72 hours of the missed evaluation) must be provided to be eligible for the make-up evaluation.** Consider visiting the Health Clinic on Campus for such a request. To make an appointment call (903) 939-7870. It is the responsibility of the student to communicate with me promptly and regularly until arrangements for the missed work have been established. If this criterion is not met, make-up evaluation won't be granted. Leaving early for a break is NOT grounds for a make-up, so please make your travel plans accordingly.

Attendance: Attendance is **mandatory**. You are expected to attend to class on time and prepared. Students are responsible for all announcements made during lecture.

Cellphones and electronic devices: Cellphones are not permitted during class. At all times cellphones must be silenced and must be put away.

Artificial Intelligence Statement:

UT Tyler is committed to exploring and using artificial intelligence (AI) tools as appropriate for the discipline and task undertaken. We encourage discussing AI tools' ethical, societal, philosophical, and disciplinary implications. All uses of AI should be acknowledged, as this aligns with our commitment to honor and integrity, as noted in UT Tyler's Honor Code. Faculty and students must not use protected information, data, or copyrighted materials when using any AI tool. Additionally, users should be aware that AI tools rely on predictive models to generate content that may appear correct but is sometimes incomplete, inaccurate, taken without attribution from other sources, and/or biased. Consequently, an AI tool should not be considered a substitute for traditional approaches to research. You are ultimately responsible for the quality and content of the information you submit. Misusing AI tools in violation of the guidelines specified for this course, as described below, is considered a breach of academic integrity. Students may be subject to disciplinary action as outlined in UT Tyler's Academic Integrity Policy.

For this course, **the use of AI tools is permitted outside of class for reference, clarification, brainstorming, and general assistance.** However, **you may not submit AI-generated solutions, explanations, code, or written material as your own.** All work submitted under your name must reflect your own original work, reasoning, and understanding. Any use of AI must be acknowledged when appropriate, and you must be able to explain and defend every part of any assignment you submit.

While AI tools may provide correct answers, relying on them without fully engaging with the material can **defeat the purpose of homework as a learning tool.** Homework is designed to help you understand and apply the material, which is essential for success in this course. If you copy or closely reproduce AI-generated work without understanding it, you may be unprepared for in-class evaluations, during which **no electronic devices, including AI tools, will be allowed.** Ultimately, inappropriate or excessive reliance on AI may negatively affect your performance on exams and your overall understanding of the course material.

UT Tyler a Tobacco-Free University: All forms of tobacco will not be permitted on the UT Tyler main campus, branch campuses, and any property owned by UT Tyler. This applies to all members of the University community, including students, faculty, staff, University affiliates, contractors, and visitors. Forms of tobacco not permitted include cigarettes, cigars, pipes, water pipes (hookah), electronic cigarettes (vaping), smokeless tobacco, snuff, chewing tobacco, and all other tobacco products. There are several ces-

sation programs available to students looking to quit smoking, including counseling, quitlines, and group support. For more information on cessation programs please visit <https://www.uttyler.edu/offices/human-resources/wellness/tobacco-cessation/students/>.

Academic Integrity: Your work must be your own. Violations will be processed according to the established guidelines of the department, college, and university. Violations of academic integrity include, but are not limited to, cheating, fabrication, or plagiarizing. A range of academic sanctions may be taken against a student who engages in academic dishonesty.

Accessibility: The Department of Mathematics at UT Tyler offers accommodations to students with learning, physical, and/or psychological disabilities. If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and the Student Accessibility and Resources (SAR) as early as possible in the term. SAR will verify your disability and determine reasonable accommodations for this course. You can find more information in their website <https://www.uttyler.edu/academics/success-services/disability-services/>.

Take into account that once an application and supporting documentation is received, the SAR registration process may take 5-7 business days to complete. It is the student's responsibility to apply for and obtain accommodations in a reasonable time frame within the semester. No accommodation reviews will be completed during the final three weeks of the current semester unless the condition is temporary or newly diagnosed.

Policies: See <https://www.uttyler.edu/offices/academic-affairs/files/syllabus-information.pdf> for these and other important University policies including: UT Tyler Honor code, student rights and responsibilities, campus carry, UT Tyler a tobacco-free university, grade replacement and forgiveness, state-mandated course drop policy, student accessibility and resources, student absence for university-sponsored events, social security and FERPA, emergency exits and evacuation, and student standards of academic conduct.

Important Dates: To find these and other important dates visit the University academic calendar at: <https://www.uttyler.edu/academics/academic-calendar-26-27/academic-calendar-15-week-and-summer.php>.

- September 8. Census date: Date to withdraw without penalty, grade replacement deadline.
- October 30. Last day to withdraw from one or more courses with a W.
- Final: Tuesday December 8th.