THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

Department of Mathematics

MA 361-2F **Syllabus: Introduction to Mathematical Modeling** **Fall 2022**
(Also MA 519-2F)

Instructor: Dr. John Mayer **Co-Instructor**: Mr. Thomas Sirna

jcmayer@uab.edu tsirna@uab.edu

Office: UH 4022 Office: UH 4027
Zoom office: 939-460-2319 Zoom office: 810-460-5149
Hours: TBA Hours: TBA
205-934-2154 205-934-2154

Preferred Methods of Contact: Email is the preferred method of contact if you have questions. Please expect a response within 24 hours on weekdays and a slower response on weekends. We will expect the same of you. Include MA 472-3B in the subject line of your email for a faster response. We are available to meet with you virtually via Zoom by appointment or during office hours (to be announced).

Instructional Method:

In-Person: This class will be conducted with in-person class meetings and the Canvas Learning Management system.   Check the course Canvas page often for announcements and assignments.

Time Commitment: This class meets twice per week for 1.25 hours each in the computer lab HHB 221. In addition to our class meeting time, you should spend about 6 hours per week reading, studying, preparing for class discussions, and completing assignments and models.

Course Information.

Course Number and Title: MA 361-2F – Mathematical Modeling.

Class Meeting Times: Tuesday/Thursday – 3:30 - 4:45 PM in HHB 221.

Course Description:

For most people, the value of mathematics lies in applications, and modeling is one of the most useful applications of mathematics. One may model using mathematical equations, spreadsheets, computer simulations, or physical replicas. Not all forms of modeling are applicable to all problems, but each *validated* model gives insight into how the system under study works. Mathematical Modeling is a mathematics course making extensive use of the computer in which students engage in explorations and lab activities designed to strengthen and expand their knowledge of the topics found in "elementary" mathematics (through Calculus I). Students collect data and explore a variety of situations that can be modeled using linear, exponential, polynomial, rational, and trigonometric functions. Activities are designed to have them take a second, deeper look at topics they have been exposed to previously; illuminate the connections between secondary and college mathematics; illustrate good, as opposed to poor, sometimes counter-productive, uses of technology in teaching and learning; illuminate the connections between various areas of mathematics; and engage in serious (i.e., non-routine) problem solving, problem-based learning, and applications of mathematics.

Prerequisite: MA 125 – Calculus I or equivalent.

Required Text and Course Materials:

There is no textbook; course materials will be provided through Canvas. For software, we will use *Microsoft* EXCEL, *Wolfram* MATHEMATICA, and *iseesystems* STELLA. Your personal copies of EXCEL and MATHEMATICA can be obtained from UAB-IT at no cost. A student copy of STELLA (Stella Professional) should be purchased (or licensed for a set period of time) from *iseesystems*. You will receive an email from *iseesystems* shortly after the course starts. You will need a scanning app on your smart phone or computer in order to submit PDF copies of work done for assignments and presentations.   Adobe Scan is free: https://acrobat.adobe.com/us/en/mobile/scanner-app.html

Computer Lab: The Mathematics computer lab in HHB 221 will be available for use of software. However, success in the course will be surer if you have your own computer and software**.**

Course Objectives: We will cover the following topics, using the computer software indicated.

1. Functions, rates and patterns involving real numbers, using MATHEMATICA, EXCEL, and STELLA.
2. Exploring the concept of *feedback* in a system using STELLA.
3. Regression and modeling, using EXCEL.
4. Exploring functions in other number systems (e.g., complex numbers), using MATHEMATICA.
5. Final modeling project and report, using MATHEMATICA, EXCEL, or STELLA.

There is no formal textbook for the course, but there will be many handouts of assignments and instructions distributed through Canvas. It is strongly recommended that you have your own computer and that you secure your own copies of the software. The mathematics behind the models will be discussed, assuming knowledge of algebra and functions (including linear functions, polynomials, rational functions, and exponential functions), differential calculus (limits, derivatives as rates of change, and linear approximation), and the definition and interpretation of the integral (as an accumulator and as area under a curve).

Learning Outcomes. Students will

1. Demonstrate ability to use Mathematica, Excel, and Stella to model dynamical systems.
2. Articulate understanding of functions, rates, and patterns involving real numbers used in modeling situations.
3. Articulate understanding of functions involving complex numbers.
4. Articulate understanding of the linear regression process and of fitting polynomial trendlines to data, in general.
5. Articulate understanding of feedback in systems that evolve over time.
6. Articulate understanding of the mathematics behind the modeling software.

Course Grades. Students earn their grade in the course as determined in the tables below. How each grade component is determined is described in the paragraphs that follow. Points accumulated will be recorded in CANVAS within one week of the completion of the assignment or activity. Important due dates will be listed in CANVAS calendar. Recall that a grade of **D** cannot count toward the mathematics major.

Grade Element	Points		Points Earned	Course Grade
Tests/Quizzes	50-100		350 points or more	A
Participation	70		300-349 points	B
Assignments	130		250-299 points	C
Final Project	100-150		200-249 points	D
Total	**400**		Below 200 points	F

Late Assignment Policy: Assignments no more than one class meeting late will be subject to a 10% grade penalty. Assignments more than one class meeting late are subject to greater penalty at the discretion of the instructor.

Participation. You are expected to participate actively, particularly in small group work and class processing discussions. Mere presence does not constitute ACTIVE participation. Participation points are awarded as in the following table. Note that it is possible to earn MORE than 70 points total for the semester since we will have about 29 class meetings. Points earned beyond 70 are extra credit. Priority in presenting goes to students with the fewest Participation points.

Level of Participation	Points
Be present in class	1
Make minimal presentation or contribute meaningfully to class/group discussion	2
Contribute significantly to class discussion	3
Make good presentation (substantially correct)	4
Make excellent presentation (completely correct)	5

Assignments. This is an inquiry-based course. Therefore, nearly all assignments will begin in class with you working with other students in a group. Groups are assigned by the instructor. Assignments will be due on a weekly basis by deadlines posted in Canvas. This component of your grade will count 120 points. You may discuss assignments with other students in the class, as well as with the instructional personnel, and you may work together with other students. If two or more students work on an assignment together, you may turn in a single "partnership" assignment with multiple names. However, you are responsible for learning the material, and you will be expected to perform on your own, particularly on tests and the final project, described below. You will have the opportunity to present your work or that of your group in class as part of participation in processing.

Tests and Quizzes. There will be two tests, one at about 7 weeks and another during the final exam period, focused on determining whether or not you have learned independently to use the tools and to understand the basic building blocks relevant to the kinds of models we are constructing. The tests will be timed, open book/notes, and will have a computer component. Even if you work with colleagues on assignments, it is vital that you learn to "drive" the computer yourself. The tests will also include questions designed to determine if you understand the mathematics and logic behind the computer models. There will be a few unannounced quizzes. This component of your work will count 50-100 points, whichever is better for your cumulative grade.

Final Projects. About midway through the course you will be provided with a list of several potential modeling stories, describing realistic situations to be modeled. Many of the projects are best modeled using Stella. You will be working as a team with others on the same model for your project. The team will present to the instructor a working model at least three weeks before the project due date, for a preliminary evaluation. The instructor will discuss your model with you promptly. Subsequently, you will revise it, if needed, and write a 5-10 page technical paper (plus Appendices) describing your model, following a Technical Paper Template we will provide. Each student must write a completely independent paper and show that they have individually exercised the model. The instructor will also give you a copy of the Scoring Guides to be used to grade your model and paper. This component will count 100-150 points, whichever is better for your cumulative grade.

Make-Up Policy. There are no make-up quizzes or presentations for absences resulting in decreased participation or quiz credit. If you miss a class for a verifiable emergency, illness, necessary medical appointment, COVID isolation or on UAB official business, the instructor will work with you to find a reasonable accommodation.

Rules for Group Work

1. Each member takes responsibility for his/her own learning.
2. Each member of the group is willing to help every other group member <u>who asks for help</u>.
3. Groups may ask the teacher for help only when <u>all</u> group members have the same question.
4. There is always a further challenge.

These rules apply during all small group discussions. Whole group discussions require adherence to the standard rule of classroom engagement: speak and listen respectfully.

Scoring Rubic (10 Point Scale)

	Conceptual Understanding: *Interpreting the concepts of the task and translating them into mathematics* *(Identifying the "core" of the problem)*	Evidence Of Problem Solving: *The use of task-appropriate tools and problem solving strategies.*	Explanation: *Using verbal reasoning and appropriate constructions to best convey the solution.* *(The explanation flows smoothly.)*	Accuracy: *Providing a wholly justified solution for the task at hand.*
3			Explanation is coherent, and the ideas involved follow logically from previously stated ones.	The solution is completely justified, with no gaps in the argument.
2	Student's work has demonstrated that he/she has fully identified the major concepts of the task.	The student's work has demonstrated the strategic use of all task-appropriate tools and problem solving methods.	Explanation is not sufficiently rigorous or something may not immediately follow from what is written.	The solution has one or two minor gaps in justification.
1	Some, but not all, of the major concepts needed were evident.	Not all tools needed for the task are used or the tools are not used in a manner appropriate for solving the problem.	Explanation has multiple gaps or multiple steps need to be inferred.	The solution has major gaps in the justification.
0	Does not achieve minimal requirements for 1 point	Does not achieve minimal requirements for 1 point	Does not achieve minimal requirements for 1 point	Does not achieve minimal requirements for 1 point

The scoring rubric is applied to assignments and test and quiz questions. There are separate rubrics for the Final Modeling Project and Technical Report.

MA 519 Students Only. MA 519 is scheduled with MA 361; MA 519 students participate in all class activities described above without distinction being made between MA 361 students and MA 519 students. MA 519 students have an additional requirement: submit a 3-5 page detailed reaction and evaluation report on the final project of another group. This report counts 50 points toward your final grade, and the scale for each letter grade is increased by 50 points: A—400, B—350, C—300, F—below 300. (No "D" for graduate students.)

UAB Policies and Resources.

Add/Drop and Course Withdrawal

- Drop/Add: Deadlines for adding, dropping, or withdrawing from a course and for paying tuition are published in the Academic Calendar available online. Review the Institutional Refund Policy for information on refunds for dropped courses.

- Withdrawal: To avoid academic penalty, a student must withdraw from a course by the withdrawal deadline shown in the academic calendar and receive a grade of W (withdrawn). Failure to attend class does not constitute a formal drop or withdrawal.

UAB United: Suppression of COVID

- Please go to the UAB United website for guidance and resources related to our safe entry to campus in Fall 2022. In particular, do not come to class if you are experiencing COVID symptoms.

- Masks and Social Distancing Requirements: Follow UAB and CDC guidelines for the health and well-being of all faculty, staff, and students, including any requirements for facemasks indoors and social distancing. These requirements may be updated from time to time.

- Non-compliance with the items will result in students not being able to remain on campus or participate in any in-person classes, meetings, jobs, extracurricular activities, and events.

- We urge you strongly to be fully vaccinated. Here is information on the safety of vaccines. There are also incentives for getting vaccinated.

Misconduct: The University of Alabama at Birmingham expects all members of its academic community to function according to the highest ethical and professional standards. Students, faculty, and the administration of the institution must be involved to ensure this quality of academic conduct. Review the Academic Honor Code and Non-Academic Student Code of Conduct linked below.

- Academic Integrity Code

- Non-Academic Student Code of Conduct

DSS Accessibility Statement: UAB is committed to providing an accessible learning experience for all students. If you are a student with a disability that qualifies under Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act, and you require accommodations, please contact Disability Support Services for information on accommodations, registration and procedures. UAB Disability Support Services (DSS) has established a process for UAB students to request temporary adjustments based on the impact of COVID-19. Requests for reasonable accommodations involve an interactive process and consist of a collaborative effort among the student, DSS, faculty and staff. If you are registered with Disability Support Services, please contact DSS to discuss accommodations that may be necessary in this course. If you have a disability but have not contacted Disability Support Services, please call (205) 934-4205, visit their website, or their office located in Hill Student Center Suite 409.

Title IX Statement: The University of Alabama at Birmingham is committed to providing an environment that is free from sexual misconduct, which includes gender-based assault, harassment, exploitation, dating and domestic violence, stalking, as well as discrimination based on sex, sexual orientation, gender identity, and gender expression. If you have experienced any of the aforementioned conduct we encourage you to report the incident. UAB provides several avenues for reporting. For more information about Title IX, policy, reporting, protections, resources and supports, please visit UAB Title IX webpage for UAB's Title IX, UAB's Equal Opportunity, Anti-Harassment, Duty to Report, and Non-Retaliation policies.