THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

## Department of Mathematics

**MA 519-3B** **Syllabus: Introduction to Mathematical Modeling** **Fall 2021**

**Instructor:** Dr. John C. Mayer **Contact Information:** jcmayer@uab.edu

**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. I will expect the same of you. Include MA 361-3B in the subject line of your email for a faster response. I am available to meet with you virtually via Zoom by appointment or during my virtual office hours.

**Office (UH 4022 or Zoom):**

**Hours:** Monday/Wednesday 4:00-5:00 PM **Zoom Contact:** 939-460-2319

**Instructional Method:**

**Remote and In-Person:** This class will be conducted using a combination of in-person class meetings, virtual class meetings on Zoom (mainly for group work sessions, if social distancing is required), and recorded content through Canvas, Zoom, and other tools using the Canvas Learning Management system. Check course Canvas page often for announcements and assignments. Students should reserve the days and hours listed in the Class Schedule for in-person classes and online synchronous course elements, as determined by the instructor.

**Time Commitment.** This class meets twice per week for 1.25 hours each. In addition to our virtual class time, you should spend about 6 hours per week reading, studying, preparing for class discussions, and completing assignments.

**E-Learning Student Support.** For help with REMOTE technologies: https://www.uab.edu/elearning/students

## Course Information:

**Course Number and Title:** MA 519-3B – Mathematical Modeling

**Class Virtual Meeting Time in Zoom:** Monday/Wednesday – 5:30-6:45 PM

**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

**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 project, 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 the mathematics behind the modeling software.

**Zoom Etiquette:** Please observe the following "rules of the road" for our meetings on Zoom:

- Be prepared to enter class from our course Canvas Zoom page a few minutes before the scheduled time (in order to provide time to enter from the waiting room).
- Have video ON at all times. Stay in the frame, particularly when taking a quiz or test. (You may turn video off briefly, if leaving the frame for personal reasons.)
- Have audio MUTED unless you are in an active discussion (in order to minimize distracting noises).

## 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: Safe Entry to Campus

- Please go to the UAB United website for guidance and resources related to our safe entry to campus in Fall 2021
- **Mandatory Masks and Social Distancing Requirements**: In accordance with CDC guidelines and for the health and well-being of all faculty, staff and students. Students, faculty and staff are currently required to wear cloth face coverings or face masks at all times indoors and maintain social distancing (per UAB and CDC guidelines) while on the UAB campus. These requirements may be updated from time to time.
- Non-compliance with the required 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.

## Course Grading:

**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 below **C** is **F** for graduate students.

| Grade Element | Points | | Points Earned | Course Grade |
|---|---|---|---|---|
| Tests/Quizzes | 100 | | 400 points or more | A |
| Participation | 80 | | 350-399 points | B |
| Assignments | 120 | | 300-349 points | C |
| Final Project | 150 | | Below 300 points | F |
| **Total** | **450** | | | |

**Pass/Fail option.** A Pass/Fail option is not presently anticipated for this class, but COVID mitigation may cause this to change.

**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 80 points total for the semester since we will have about 29 class meetings. Points earned beyond 80 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. However, you must turn in an independently written assignment response. 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 done online, timed, and will have a computer component. You video must be ON during any test or quiz, and you must be in the frame. Even if you work with colleagues on assignments, it is vital that you learn to "drive" the computer yourself. You will have NO partner on the tests. 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 100 points.

**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 (to be announced), for a preliminary evaluation. The instructor will discuss your model with you promptly. As a graduate student, you will also write a detailed reaction to another team's project. Subsequently, you will revise it, if needed, and write a 5-10 page technical paper (plus Appendices) describing your model(s), 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(s). 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 150 points.

## 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 |

This rubric is applied to assignments and test and quiz questions. There is a separate rubric for the Final Modeling Project.

## 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 who asks for help.
3. Groups may ask the teacher for help only when all 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.

## Course Netiquette:

There are course expectations concerning etiquette on how we should treat each other online. It is very important that we consider the following values during online discussions, Zoom interactions, and email.

- **Respect:** Each student's opinion is valued as an opinion. When responding to a person during the online discussions, be sure to state an opposing opinion in a diplomatic way. Do not insult the person or their idea. Do not use negative or inappropriate language.
- **Confidentiality:** When discussing topics be sure to be discreet on how you discuss children, teachers, and colleagues. Do not use names of people or names of facilities.
- **Format:** When posting use proper grammar, spelling, and complete sentences. Avoid using ALL CAPITALS. This signifies that you are yelling. Avoid using shortcuts/text abbreviations such as 'cu l8r' for 'See you later.'
- **Relevance:** Think before you type. Keep posts relevant to the discussion topic.