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# Topics in Applied Mathematics: *Mathematical Modeling*

Math 396 Spring 2021

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<https://zoom.us/j/83746366935> T 10:15am - 11:40am

<http://sites.oxy.edu/ron/math/396/21/>

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**INSTRUCTOR** Ron Buckmire ~ he/him/his ~ x2536 ~ [ron@oxy.edu](mailto:ron@oxy.edu)

**OFFICE HOURS** My official office hours for Spring 2021 are **M 12–1pm, T 4–5pm, R 10–11am**. However, because I am an Associate Dean it is possible there may not always be open slots during these times. In that case, I **strongly** encourage you to make an individual 1-on-1 appointment to see me. My office hours occur on Zoom, at <http://occidental.zoom.us/j/3232592536> with code 235711 (i.e. the first five prime numbers!)

I am also readily accessible by e-mail at **[ron@oxy.edu](mailto:ron@oxy.edu)**

I strongly recommend that you take advantage of attending a small liberal arts college in a remote setting to interact with your professors one-to-one. Especially since all our interactions in this class will occur remotely I encourage you to interact with me directly. Although it is not mandatory, I do ask that you come and see me for a brief visit at some point early in the semester so that I can learn more about your background, interests and expectations for the semester.

**TEXTBOOK(S)** We will be using material from multiple texts during this course.

- **(RECOMMENDED)** *Mathematical Modeling*, Fourth edition by Mark Meerschaert. Academic Press, 2013. ISBN-13 978-0-123-86996-8.
- **(SUPPLEMENTAL)** *Methods of Mathematical Modelling: Continuous Systems and Differential Equations*, First Edition by Thomas Witelski and Mark Bowen. Springer, 2020. ISBN-13 978-3319230412.

**COURSE WEBSITE** <http://sites.oxy.edu/ron/math/396/21/>

**COURSE MOODLE** <https://moodle.oxy.edu/course/view.php?id=32332>

**COURSE ZOOM** <https://zoom.us/meeting/83746366935> passcode: Math396

**COURSE DESCRIPTION** This course is a project-oriented seminar in mathematical modeling. Concepts from calculus, linear algebra, differential equations and other areas of mathematics will be used to derive, describe and solve mathematical models from the life, physical, and social sciences. Familiarity with a programming language is desirable but not required. The goal of this course is to provide students with multiple examples of how mathematics can be used to explain various phenomena, to describe real-world situations and to make (more quantitatively) informed decisions.

**COURSE FORMAT** All instruction will occur remotely via videoconference. The first half of the semester will consist of class sessions where mathematical content is presented in the form of mathematical modeling techniques and examples of specific types of models used in various disciplines and context. There will be written assessments of the understanding of the mathematical concepts and content and students will hand in responses by scanning in

written solutions and uploading PDFs in the **Math 396 Spring 2021 Google Drive**. The example models will include differential equation-based models (used in modeling COVID-19 and/or cinematic box-office dynamics), probabilistic models (used in economics to describe racial discrimination), discrete/network models (used to describe social networks) and data science models (a machine learning example). In the second half of the semester students will be expected to work together in small teams/permanent groups to analyze a selected mathematical model and produce an implementation of their own that answers a question they have devised.

**COURSE OBJECTIVES** This course is designed to provide students with exposure to and the experience of the mathematical modeling of real-world phenomena by

- exposing students to mathematical models from various scientific disciplines (economics, biology, physics, data science, etc)
- allowing students to analyze, develop, test and/or implement mathematical models (that they choose or devise);
- presenting students with a different mode of classroom instruction and student involvement where students see themselves as equal participants in the education process;
- providing students with opportunities to practice and hone oral and written presentation skills of mathematical/technical content; and
- developing students' collaboration skills by working in small teams towards a common goal;

**STUDENT LEARNING OUTCOMES** The official Departmental student learning outcomes of this course are:

- Outcome 3.1: Students will write a clear and well-organized paper in the model of a scholarly paper in the field.
- Outcome 3.2: Students will give a clear and well-organized presentation on a mathematical topic.
- Outcome 5.1: Students are able to define and deploy important terms in multiple areas of advanced mathematics.
- Outcome 5.2: Students are able to provide examples that illustrate important concepts found in multiple areas of advanced mathematics.

**ASSESSMENT AND GRADING** In order to enhance equity for students, a number of Oxy faculty (including myself) are implementing “specification grading” or “contract grading” this academic year. This process involves providing students with the precise expectations for what the students need to do in order to receive a specific grade in the class. This means that although you will receive individualized feedback on all assignments (typically **exceeds expectations** or  $\checkmark$ , **meets expectations** or  $=$ , or **fails to meet expectations** or  $\times$ ). Your grade is not computed as a percentage of the available points on individual assignments or in the course as a whole. Your grade is largely independent of the performance of other students in the class

The idea behind this approach is to try to separate the grade in a course from the learning that occurs in the course. This does not mean that you will be doing less work or having your work assessed less often. It means that as the student, you have more control over what

your final course grade is, because the terms are stated clearly in the grading contract (see below).

There are multiple different categories of assignments/activities in this class: **Learning Assessment, Active Participation, Group Progress Report(s), and Group Final Reports.**

- **Learning Assessments** These are typically referred to as homework problem sets. There will be roughly five or six of these in the semester, and each student will submit their own written copy of their solutions, although you can work together to come up with your solutions. The total set of Learning Assessment will be evaluated as shown below:
  - ✓ **Exceeds expectations** will refer to work that not only demonstrates complete understanding of the concepts involved, but goes beyond what is expected, either by doing extra work or a bonus problem, or turning in your work in word-processed format (i.e. using  $\text{\LaTeX}$ ), or extending the problems in some unexpected or advanced way (i.e. writing a code to solve more than just the problem at hand). *You need more exceeds expectations than below expectations to reach this value.*
  - = **Meets expectations** will refer to work that is handed in on time, is generally correct, and reflects some understanding of the concepts in the problems. There may be some incorrect problems or minor typographical errors or untidiness. *You need equal number of exceeds expectations and below expectations to reach this value.*
  - × **Below expectations** will refer to work that is late or absent or contains solutions or mathematics that is mostly incorrect or demonstrates significant misunderstanding of the concepts. *You need more below expectations than exceeds expectations to reach this value.*
- **Active Participation Events** These are the class meetings on Tuesdays from 10:15am to 11:40am where synchronous interaction between students and between students and the instructor will generally occur. In the first half of the semester, synchronous attendance is expected during the regularly scheduled times, and in the second half of the semester when you will be working in self-organized groups it will involve synchronous interaction with your group members (and sometimes with me). **Come see me if synchronous attendance at a specific time will not be possible for you and we will try to make an accommodation.**
  - ✓ **Exceeds expectations** will be achieved in this category if a student attends all of the required synchronous meetings.
  - = **Meets expectations** will be achieved in this category if a student attends **almost all** of the first seven synchronous class meetings **as well as** the Progress Report Event (on **Tuesday March 30**) and Final Project Presentations (on **Tuesday April 27**).
  - × **Below expectations** will be achieved in this category if a student misses either the Progress Report Event, the Final Project Presentations or two of the Model Presentation Days during the first half of the semester.
- **Group Progress Report** This is a short (5-10 minute) synchronous oral presentation by the student groups (currently scheduled for Tuesday March 30 but subject to change) giving progress on their selected model to the entire class.
  - ✓ **Exceeds expectations** will be achieved in this category if the group presentation is satisfactory and demonstrates meaningful progress on the selected model.
  - = **Meets expectations** will be achieved will be achieved if a student satisfactorily participates in the progress report presentation

- × **Below expectations** will be achieved if a student doesn't satisfactorily participate in the progress report presentation.
- **Group Final Report** This is a 20-minute synchronous oral presentation by the student groups (currently scheduled for Tuesday April 27) **as well as** a maximum 12-page written presentation summarizing the results of the work done by the groups (currently due Tuesday May 4).
  - ✓ **Exceeds expectations** will be achieved in this category if the Final Report follows the guidelines of duration, length and demonstrates more than satisfactory progress by the group.
  - = **Meets expectations** will be achieved if the Final Report follows the guidelines of duration, length and demonstrates satisfactory progress by the group.
  - × **Below expectations** will be achieved if the Final Report fails to follow the guidelines of duration, length or demonstrates unsatisfactory progress by the group.

**GRADING CONTRACT** This section defines the minimal requirements that need to be achieved in order to achieve the specified grade range.

To **earn an A**, a student must

- Receive **exceeds expectations** in at least one individual category (Participation Events and Learning Assessments) and at least one group category (Progress Report(s), Final Oral Presentation, Final Written Presentation)
- Receive **meets expectations** in all the other categories.
- Not receive **below expectations** in any category

To **earn a B**, a student must do all of the following:

- Receive **exceeds expectations** in at least one category
- Receive **meets expectations** in at least one category

To **receive credit for the class/earn a C**, a student must do all of the following:

- Receive either **meets expectations** or **exceeds expectations** in more than one category

(Note: A+ is not an available grade at the College.)

**The grades A-, B- and C- will be determined at the discretion of instructor** based on partial fulfillment of the specification for a particular grade range.

**The grades B+, and C+ will be determined at the discretion of the instructor** based on exceeding the minimum fulfillment for the grade range or may also include overall level of engagement with the class

#### **Academic Flexibility: Extra Credit Tokens**

In order to provide students with academic flexibility to deal with unexpected situations that may negatively impact your ability to do your best work in the class, all students are provided with **three tokens** that they can use to alleviate situations, circumstances or problems that would otherwise negatively impact their performance. For example, one can use a token to re-submit an assignment that has been assessed as *below expectations* or to extend the deadline on an assignment, or to do a make-up assignment. Tokens are **not** "get out of jail free" cards; they can only be used if you have consulted with the instructor in advance and received permission to use the token in the requested way. You do not have to provide a

reason for why you want to use the token. However, you cannot miss a deadline and then after the fact ask to use a token to submit the assignment late. Although each student begins with three tokens, there will be extra credit opportunities that will serve to earn you tokens.

**FINAL EXAM** There will be no final exam in this class.

**LEARNING ENVIRONMENT** As you know, all instruction in Spring 2021 will be remote and this section discusses the online learning environment.

**Community Agreement** I aim for this course to be an enjoyable, interesting and empowering experience for **every participant**. Together we can and will build an academic experience where all are welcomed, supported and challenged. Please be active, critical, patient, prepared, curious and generous in your learning and that of your classmates.

**Acceptable Behavior** As a student participating in an online learning environment, you must abide by all College rules and regulations including, but not limited to, rules in the course syllabus, the Student Code of Conduct Policy, the Policy on Sexual Harassment and Discrimination, as well as any applicable laws. Any violation of these rules may lead to disciplinary action, up to and including expulsion from the College, and/or legal action.

**Recording Classes** (Portions of) Some class sessions will be recorded in the first-half of the semester. This means that the audio-visual and chat portions of each class may be recorded and then stored on the Colleges servers. These recordings will be made available through Moodle, but only for the express and sole use of those registered in the course. This is done to assist students in time zones far from California's to have equitable access to the course content in an asynchronous fashion. The recorded material will be removed at the end of the semester. No other recording of classroom instruction is permitted. Students are required to provide consent to the recording or to contact the professor to come to an accommodation if they do not consent to their audio, video or chat being recorded. The sharing, altering, or distorting of any audio-visual capture of a class session is not permitted. All content contained in the records shall be subject to the Colleges Policy on Intellectual Property.

**Zoom Etiquette** Each class has the ability to determine the etiquette expected of participants in Zoom. I would like the class to collaboratively determine our Zoom etiquette for Math 396, which include the following: Should students be expected to have their video cameras on all the time? Should students be expected to be muted when not speaking to prevent extraneous noise? If students do not share video, should they add a meaningful picture to their Zoom profile?

**SYLLABUS CHANGES** Any aspect of this syllabus is subject to change, at any time, although you will be notified of any changes in writing (via email and also via announcement in Moodle).

**OTHER NOTES** We will not have class on Founders Day, Tuesday April 20. All classes are cancelled for Spring Break, the week of March 8 to 12, 2021.

## COLLEGE POLICIES

**Credit Hour Policy** Math 396 is a 2-credit course. The expectation is that students will be devoting at least six(6) hours each week (including in-class time) on average working on this course.

**Discrimination, Harassment and Retaliation** The College seeks to maintain an environment of mutual respect among all members of its community. All forms of harassment and discrimination on the basis of sex, gender identity and expression, pregnancy, religion, creed, color, race, national or ethnic origin, ancestry, sexual orientation, medical condition, physical or mental disability, age, marital status, veteran status, family care leave status, political affiliation or any other class protected by federal, state or local law destroy the foundation for such respect and are violations of this policy.

<https://www.oxy.edu/student-handbook/general-college-policies/discrimination-harassment-and-retaliation>

**Accommodations for Reasons of Faith and Conscience** Consistent with Occidental Colleges commitment to creating an academic community that is respectful of and welcoming to persons of differing backgrounds, we believe that students should be excused from class for reasons of faith and conscience without academic consequence. While it is not feasible to schedule coursework around all days of conviction for a class as a whole, faculty will honor requests from individual students to reschedule coursework, to be absent from classes that conflict with the identified days. Information about this process is available on the ORSL website: <https://www.oxy.edu/office-religious-spiritual-life>

**Language on Special Accommodations/Learning Differences** No matter the mode of course instruction, approved academic accommodations remain in effect. Students with documented disabilities and learning differences who are registered with Disability Services are required to present their accommodation letter to the instructor at the beginning of each semester, or as soon as possible thereafter. Any student who has, or thinks they may have, a physical, learning, or psychological disability may contact Disability Services at [accessibility@oxy.edu](mailto:accessibility@oxy.edu) to learn about available services and support. More information is available at <http://www.oxy.edu/disability-services>.

**Academic Ethics** Students are expected to comply with the Student Handbook, in particular the section on Academic Ethics. Whenever outside sources are used, they must be properly credited. <https://www.oxy.edu/student-handbook/academic-ethics/academic-ethics>.

**Academic Integrity** I expect the highest level of academic honesty from my students. Students are responsible for knowing the Academic Misconduct policies found here: <https://www.oxy.edu/student-handbook/academic-ethics/academic-misconduct> I would like to alert students to the official Principle of Honor found in the Student Handbook: **“No student shall take unfair advantage of another student or member of the Occidental Community” - ASOC Constitution, Article VI, Section 1B.** I trust that you will follow this principle and act with integrity and respect for others.

**Title IX** In the event that you choose to write or speak about having experienced sexual or interpersonal violence, including sexual assault, dating violence, domestic violence, stalking, sexual exploitation or any other form of sexual harassment, federal and state education laws require that, as your instructor and a designated Responsible Employee, I notify the Title IX office. They will contact you to let you know about accommodations and support services at Oxy and reporting options both on and off-campus.

If you do not want the Title IX Office notified, instead of disclosing this information to your instructor, you can speak confidentially with the following people on campus:

Marianne Frapwell, Survivor Advocate, Project SAFE (survivoradvocate@oxy.edu)

Emmons Counseling (For appointments, call: 323-259-2657)

Rev. Dr. Susan Young, Office of Religious and Spiritual Life (young@oxy.edu)

The sexual misconduct policy, along with additional resources, can be found at: <http://www.oxy.edu/sexual-respect-title-ix/policies-procedures>. If you would like to contact the Title IX Office directly, you can email Title IX Coordinator Alexandra Fulcher at [afulcher@oxy.edu](mailto:afulcher@oxy.edu) or call 323-259-1338.

## COLLEGE RESOURCES

**Student Academic Support Resources** The College has numerous resources to support and promote student success. These can be accessed at <https://www.oxy.edu/academics/student-success>

**Writing Assistance** The Writing Center (WC) can help you with papers for this class (and any other class), at any stage in your writing process, from generating ideas to revision. The WC provides two types of support: appointments with peer Writing Advisers and with Faculty Specialists. You can find more information about the Writing Center, including how to sign up for an appointment (synchronously through Zoom or to receive asynchronous feedback), on the WC website: <https://www.oxy.edu/writing-center>.

**Intercultural Community Center** The ICC seeks to uplift and support the experiences of students who identify as BIPOC, LGBTQIA+, low-income or first-generation college students. The ICC also aims to reduce institutional barriers for minoritized groups through intersectional programming, identity-specific services and structural resources. To learn more, contact [icc@oxy.edu](mailto:icc@oxy.edu), or reach out directly to Chris Arguedas, at [carguedas@oxy.edu](mailto:carguedas@oxy.edu).

**Lived Name Policy** Occidental College seeks to provide an inclusive and non-discriminatory environment by making it possible for students to use a lived first name and pronouns on college records when a legal name is not required. Students are encouraged to use Zoom to display their lived name and pronouns. These can be set at <https://occidental.zoom.us/profile>. I encourage all students to include their lived names and pronouns after consulting this policy: <https://www.oxy.edu/student-handbook/general-college-policies/lived-name-pronoun-policy>

**Student Health/Emmons** Your health and well-being has always impacted learning and academic success, and this reality is only heightened as we learn and live through a global pandemic. Symptoms such as anxiety, depression, loss of motivation, difficulty concentrating, and strained relationships can occur. Emmons Counseling staff are committed to supporting the mental health needs of all of our students, regardless of where you're located. Emmons provides virtual walk-ins, crisis support, and consultation to all students, and ongoing individual telecounseling to students residing in California. All students residing outside of California will have access to ongoing telecounseling through a national telecounseling service. Emmons also assists students with finding local therapy referrals. All students continue to have access to the 24/7 confidential hotline at (323) 341-4141. To get connected to any of the free, confidential services at Emmons call (323) 259-2657 or schedule an appointment online at <https://myhealth.oxy.edu> using your Oxy login credentials.