Course Description

*From General Catalog:* Basic concepts of differential calculus with life science applications. Not intended for physical science or engineering majors. Not open to students with credit in Mathematics 150.

*Prerequisite:* Satisfaction of Entry-Level Mathematics requirement, or Math 105 or 141 with C or better.

*This semester:* First and foremost, this course is about the problem of mathematical modeling: building simple, empirically testable representations of real-world systems. Through the process of modeling, biology and mathematics can work together to solve interesting problems in the real world. Biological problems push us to develop new mathematical techniques, or apply old techniques in novel ways. Correspondingly, mathematical tools provide better qualitative and quantitative understanding of biological problems, and can provide evidence to support or reject the current theories we use to understand the world.

This course will teach you how to use many of the same mathematical tools found in a mainstream Calculus I class (like Math 150). Some of the most important tools are functions, which allow us to describe relationships between two quantities, and discrete dynamical systems and the derivative, which are used to describe and calculate how things change. In this course, you will learn how to use these tools to model the behavior of a wide variety of real-world phenomena. In addition, the lab component of this course will teach you how to use Maple, Excel, and Word to calculate the details of mathematical models and communicate your results to other professionals in the field.


Much of the textbook material is also available on Prof. Mahaffy’s website, linked on Blackboard. You will also need an i>Clicker 2. These are available at the bookstore.

**Learning Objectives**

By the end of the semester, you will be able to:

- Model real-world data with mathematical functions and discrete dynamical systems
- Choose appropriate models for different sets of data
- Assess the goodness of fit of your models
- Make predictions about real-world phenomena using mathematical models
- Explain how mathematics applies to your field of interest
- Compute the derivative of mathematical functions
- Use the derivative to find critical points, concavity, and rates of change, and optimize quantities

In addition, the lab portion of the class will help you learn to:

- Use Excel and Maple to compute the details of mathematical models
- Create informative and accessible technical documents
- Communicate your results with professional communities
**Peer Instruction: What and Why**

Learning math is not simply a matter of acquiring correct knowledge. You need to learn to use new conceptual tools, and integrate them with your existing ways of thinking. What this means is that I cannot transmit knowledge from my brain to yours – you have to take an active role in the learning process.

Each class meeting will include not only lecture, where I tell you new things, but also peer instruction questions, where you think about the material, discuss it with your fellow students, and check your understanding by using your clicker to select an answer. This will help you stay involved and active during class, test yourself in a low-stakes environment, and thus master the course content.

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**Tentative Schedule of Topics**

<table>
<thead>
<tr>
<th>Week</th>
<th>Monday</th>
<th>Wednesday</th>
<th>Week</th>
<th>Monday</th>
<th>Wednesday</th>
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<tbody>
<tr>
<td>1 - Jan 20</td>
<td><strong>Martin Luther King Jr. Day</strong></td>
<td>Introduction Linear models</td>
<td>9 - Mar 17</td>
<td>Applications of the derivative</td>
<td>Graphing with the derivative</td>
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<tr>
<td>2 - Jan 27</td>
<td>Least squares</td>
<td>Function review, quadratic functions</td>
<td>10 - Mar 24</td>
<td>Review</td>
<td>Exam 2</td>
</tr>
<tr>
<td>3 - Feb 3</td>
<td>Quadratic functions</td>
<td>Other functions and asymptotes</td>
<td>11 - Mar 31</td>
<td>Spring Break</td>
<td>Spring Break</td>
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<tr>
<td>4 - Feb 10</td>
<td>Allometric models</td>
<td></td>
<td>12 - Apr 7</td>
<td>Derivatives of $e^x$ and $\ln(x)$</td>
<td>Product rule</td>
</tr>
<tr>
<td>5 - Feb 17</td>
<td>Review</td>
<td>Exam 1</td>
<td>13 - Apr 14</td>
<td>Quotient rule</td>
<td>Chain rule</td>
</tr>
<tr>
<td>6 - Feb 24</td>
<td>Discrete dynamical systems</td>
<td>Discrete dynamical linear models</td>
<td>14 - Apr 21</td>
<td>Optimization</td>
<td></td>
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<tr>
<td>7 - Mar 3</td>
<td>Introduction to derivative</td>
<td>Tangent lines, velocity</td>
<td>15 - Apr 28</td>
<td>Nonlinear discrete systems</td>
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<tr>
<td>8 - Mar 10</td>
<td>Limits</td>
<td>Rules for the derivative</td>
<td>16 - May 5</td>
<td>Applications of nonlinear sys.</td>
<td>Final review</td>
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**Evaluation**

*Lecture material* makes up 2/3 of your grade.

Peer instruction (Clickers) .... 10% (Quizzes and participation; lowest four participation scores dropped)

Homework .................................. 20% (WeBWorK and written assignments; usually due Tuesday nights)

Exam 1 .................................... 20% (Tentatively scheduled for Wednesday, February 19)

Exam 2 .................................... 20% (Tentatively scheduled for Wednesday, March 26)

Final ...................................... 30% (**Monday, May 12, 1pm – 3pm, HT 140**)  

*Lab material* makes up the other 1/3 of your grade. There will be 8-10 lab reports, plus 3 exams that each count as two assignments. Lab reports will be due **Thursdays at midnight** in the Math 121 box in GMCS 425. Late lab reports will be downgraded by 50%. Missing a lab session will result in an automatic 10-point deduction from your lab report score.

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**Grading Scale**

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>92 – 100%</td>
<td>A</td>
</tr>
<tr>
<td>90 – 91%</td>
<td>A-</td>
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<tr>
<td>83 – 86%</td>
<td>B</td>
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<tr>
<td>73 – 76%</td>
<td>C</td>
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<tr>
<td>67 – 69%</td>
<td>D+</td>
</tr>
<tr>
<td>60 – 62%</td>
<td>D-</td>
</tr>
<tr>
<td>Below 60%</td>
<td>F</td>
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**Tips for Succeeding in This Course**

- Come to class and participate in discussions
- Start your homework early
- Come to office hours
- Study in groups (labs encourage you to do this)
- Communicate problems early
- Read course materials before and after class
Accommodations for Students with Disabilities
I enthusiastically support the mission of Student Disability Services to make education accessible to all. Students who need accommodation of their disabilities should contact me privately to discuss specific accommodations for which they have received authorization. If you need accommodation due to a disability, but you have not registered with SDS (Calpulli 3101), please do so before making an appointment to discuss accommodations.

What I Expect From You
• In lecture, contribute regularly to both whole-class and small-group discussions in lecture
• In lab, work together with your partner; don’t rely too much on help from your lab assistant
• Communicate respectfully

What You Can Expect From Me
• Prompt and clear grading of homework, exams, and lab reports
• Fair exams that fit the allotted time and accurately represent the material covered
• Prompt responses to emails

Academic Integrity
It is often useful to collaborate with other students when doing the homework problems, and I encourage this, as it helps you learn how to communicate. It is also useful to learn how to use technology to help solve mathematical problems. However, no cheating of any kind will be tolerated, and if necessary, I will file Academic Dishonesty Incident Report forms with the Center for Student Rights and Responsibilities.
  • Do not present someone else’s work as your own. This is called plagiarism.
  • Clicking in for someone else is also cheating. If you are found with two clickers, the owners of both clickers will receive a non-droppable zero for that day’s clicker points.
  • Cellphones must remain in your pocket or purse during all exams. If I see your cellphone during an exam, you will receive a zero for that exam.
  • Copying others’ work during exams will likewise result in you receiving a zero for the exam. Penalties for academic dishonesty will be assessed in line with University policy and may include failing the assignment, lowering your course grade, failing the course, or expulsion from the university.

Weekly Calendar
Here is a calendar with the time and location of each of the weekly meetings and office hours.