MATH 325 Mathematical Modeling

David Gerberry

Follow this and additional works at: http://www.exhibit.xavier.edu/mathematics_syllabi_fall_2014

Recommended Citation
http://www.exhibit.xavier.edu/mathematics_syllabi_fall_2014/21

This Restricted-Access Syllabus is brought to you for free and open access by the Mathematics Syllabi 2014 at Exhibit. It has been accepted for inclusion in Mathematics Syllabi Fall 2014 by an authorized administrator of Exhibit. For more information, please contact exhibit@xavier.edu.
**David Gerberry**  
Assistant Professor  
Mathematics & Computer Science  
3800 Victory Parkway  
Cincinnati, OH 45207-4441  
Phone: (513) 745-4254  
Fax: (513) 745-3272  
Email: david.gerberry@xavier.edu  
URL: www.cs.xavier.edu/~david.gerberry

**Fall 2014 Office Hours:**  
M 12:30-2:30,  
W 10:00-11:00,  
W 12:30-2:00,  
or by appointment,  
or just stop by  
Office: Hinkle 111

---

**MATH 325 - Mathematical Modeling - Fall 2014**

**Instructor:** David Gerberry  
**Schedule:** MWF 9-9:50am in MCD 130  
**Textbook:** *A Course in Mathematical Biology: Quantitative Modeling with Mathematical and Computational Methods*,  

**XU Catalog Description:** The synthesis, formulation and solution of various problems in applied mathematics and related fields.

**My Description:** This course is an exploration in applications of mathematics to various subjects. Given that my research area is mathematical biology, there may be a slight bias toward biological applications. However, the skills you will learn are applicable to a wide array of fields.

While mathematical models have been used in physics and economics for some time, they have only recently (~ last 15 years) come to the forefront of fields such as chemistry and biology. Even more recently since the rise of social media, google, online shopping (i.e. the era of `big data’), mathematical modeling has become important in the social sciences as well; including psychology, political science and criminal justice. Even within the fields we have mentioned above, there is a wide range of topics that mathematical modeling can address. In biology alone for example, subtopics would include ecology (animal behavior), immunology, epidemiology, physiology, genetics and medicine.

By the end of this course you will be able to derive, interpret, solve, simulate, understand, discuss and critique discrete and differential equation models (at least, we will...
also cover a subset of partial differential equation, stochastic and cellular automata models) of various systems. In this course, you will not only learn about modeling; you will actually do modeling.

**Course objectives:**
1. You will be able to derive mathematical models.
2. You will be able to interpret mathematical models.
3. You will be able to solve mathematical models.
4. You will be able to simulate mathematical models.
5. You will be able to understand mathematical models.
6. You will be able to discuss mathematical models.
7. You will be able to critique mathematical models.
8. You will have completed a substantial modeling project on a topic of your own choosing and you will have artifacts (slides from your presentation and written report) of your successful completion of the project.

**Grades:**

We will use the following scale for letter grades:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>90-100</td>
</tr>
<tr>
<td>B</td>
<td>80-89</td>
</tr>
<tr>
<td>C</td>
<td>70-79</td>
</tr>
<tr>
<td>D</td>
<td>60-69</td>
</tr>
<tr>
<td>F</td>
<td>&lt; 60</td>
</tr>
</tbody>
</table>

Grades will be calculated as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignments</td>
<td>40%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>20%</td>
</tr>
<tr>
<td>Project</td>
<td>40%</td>
</tr>
</tbody>
</table>

**Assignments:**

The term "assignment" will be fairly general this semester. Assignments will include

1. Reflections/responses to reading assignments
2. Small presentations you make to the class
3. Standard HW assignments (e.g. math problems from the book)
4. Summaries, critiques of modeling papers
5. Small programming assignments to implement different types of models

Different point values will be assigned to these varied types of "assignments" to reflect their importance, difficulty and the time needed for each (e.g. a short HW assignment may be worth 7pts and a presentation of an article in class worth 25pts).

**Quizzes:**
We will have quizzes (or small exams) that assess our grasp of the theoretical results and computational skills that go into each of the types of mathematical models we discuss. Mathematical modeling does not lend itself well to typical "math tests," so these assessments will be short and somewhat infrequent. The assessments may be in-class or take-home.

Project:

Each student will complete a substantial modeling project on a topic of their choosing this semester. The project will be completed in several stages and will constitute a significant portion of the semester grade. We will dedicate a significant amount of class time to your projects.

Canvas:

Canvas will be used to post grades for this course throughout the semester and possibly for announcements (if this proves to work better than email). All assignment documents and course material will be posted on this website. I will post assignments on Canvas so they show up in your calendar.

Collaboration:

You are strongly encouraged to work with fellow students on homework assignments. Mathematics, in general, is best when done with friends. Very few research papers in math have only one author. Doing HW with others helps to avoid frustration particularly if you are making some small mistake that would take you hours to find on your own. Keep in mind though, that collaboration on exams is frowned upon. In fact, we call it cheating, so it is very important that collaboration on HW is done in a way that develops your own ability to solve the assigned exercises.

Disability Services:

For students with documented disabilities, the Learning Assistance Center provides accommodations such as extended time on exams, reduced distraction testing environment, note-taking assistance, and assistive technology. These services are provided in a positive and encouraging environment which promotes appreciation for diversity and Cura Personalis. If you feel that you may require these services, please contact me or the Learning Assistance Center directly as soon as possible to arrange for appropriate services.

Disclaimer:

Things in life happen that are much more important than this course. While the course policies are "set in stone," please inform me if serious issues come up (e.g. family emergencies, health issues, etc.). Under such circumstances, all policies are flexible and we will find a workable solution that lets you deal with what is important and still get a grade that reflects your understanding of the course material. If something does come up, please alert me via email and/or phone as soon as possible so I don't worry or simply assume you are slacking off.

COMAP:

The "Mathematical Contest in Modeling" put on by COMAP (the Consortium for Mathematics and Its Applications) is an annual, worldwide, undergraduate competition in which teams of 2-3 students develop a solution to a real world problem drawn from science, business or public policy. The contest is an excellent opportunity for students to develop creative thinking, teamwork and problem solving skills. This year's competition will be held from Thursday, February 5 - Monday, February 9, so mark your calendars. I can not make it a required component of the course, but I would if I could.
To be honest, I am not sure how many chapters of the book we will be able to cover. Committing ourselves to projects does mean we will have to sacrifice covering certain topics, but this is a good trade off. In this course, we will actually do some modeling rather than just learn about modeling.

Regardless, here is a very tentative schedule of at least the first few weeks of the semester.

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Days</th>
<th>Topic</th>
<th>Files</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aug 25-29</td>
<td>M</td>
<td>Syllabus/Introductions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>W</td>
<td>Discuss reading</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>`Best paper' presentations</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sept 3-5</td>
<td>W F</td>
<td>Introduction to different types of models</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sept 8-12</td>
<td>MWF</td>
<td>Ordinary Differential Equation Models</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Sept 15-19</td>
<td>MWF</td>
<td>Ordinary Differential Equation Models</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sept 22-26</td>
<td>MWF</td>
<td>Ordinary Differential Equation Models</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Sept 29 - Oct 3</td>
<td>MWF</td>
<td>Difference Equation Models</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Oct 6-8</td>
<td>M W</td>
<td>Difference Equation Models</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Oct 13-17</td>
<td>MWF</td>
<td>Difference Equation Models</td>
<td></td>
</tr>
<tr>
<td>9-16</td>
<td></td>
<td></td>
<td>The topics we cover will depend on class interests and projects chosen. We will also have &quot;working days&quot; for our projects and to give the class updates on our projects.</td>
<td></td>
</tr>
</tbody>
</table>

Some important dates for our projects.

**Friday, September 12:** Initial ideas about the project are due.
**Wednesday, October 8:** Formal project proposal is due.
**Monday, December 1:** Draft of written report is due.
**Week of December 8-12:** Project presentations.
**Finals Week:** Written report on project is due.
Assignments:

1. **Assignment #1**  Read and respond assignment
   - **Due Wed Aug 27**
   - turn in through CANVAS

2. **Assignment #2**  Best paper assignment
   - **Due Thurs Aug 28 @ 11:59pm**
   - submit the pdf of your article through CANVAS
   - Gerberry: HIV Treatment as Prevention, BOIDS, Emergent Group Intelligence, Zombies, Bieber Fever

3. **Assignment #3**  Initial ideas about project
   - **Due Fri Sept 12**
MATH 325: Anonymous Comments

General comments about the course. They can be left anonymous or you can add your name.
This can be used for anything you would like to say about the course. Examples could include, "I hate Section 1.3. I am totally confused. I think everyone is.", "I am really upset that you changed the Exam date to next Friday. It doesn't work for me at all.", "The people in the back of the room are distracting/annoying/cheating/whatever. Can you get this in check, please?" or "Everyone is scared to death of the project business. How can it be worth 40% of the final grade?"

Submit

Never submit passwords through Google Forms.