BISC-599: Modeling and Numerical Techniques for Marine Scientists
Units: 2.0

Spring 2015, Wednesdays 3-4:50pm

Location: TBD.

Max enrollment: 10

Instructor: Prof. Naomi Levine
Office: AHF M225
Office Hours: Thu 11:30 a.m. – 12:30 p.m.
Contact Info: 213-821-0745, n.levine@usc.edu
Course Description
Numerical models provide an invaluable tool for interpreting observations, making predictions, and generating hypotheses. Biological oceanographers face the difficult challenge of interpreting their findings in the context of a dynamic physical and chemical environment. Especially in light of recent dramatic increases in both the size and complexity of marine data sets, oceanographic research increasingly requires the use of sophisticated numerical approaches for data interpretation and analyses. This course will provide students with a basic set of quantitative and computational skills that will facilitate their research. Specifically, the course will cover the statistical analyses of data sets, the development of modeling frameworks, numerical models of varying complexity, and techniques for analyzing model results.

Learning Objectives
This course will provide students with proficiency in MATLAB, a powerful computational tool for data analysis and model construction. In addition, students will build a toolbox of statistical techniques including probability distributions, error propagation, least squares and regression techniques, principle component and factor analysis. Finally, they will construct and use 0D, 1D, and 2D ocean models and learn how to interpret the output from complex 3D global ocean models.

Prerequisite(s): none
Recommended Preparation: suggested reading MATLAB Primer (Timothy Davis, 8th edition)

Technological Proficiency and Hardware/Software Required
This course will use MATLAB as a platform to provide examples for topics discussed during the lectures and for problem sets.

Required Readings and Supplementary Materials
Required:

Supplementary Materials:
Statistics and Data Analysis in Geology, John Davis, John Wiley & Sons
Data Reduction and Error Analysis for the Physical Sciences, Philip R. Bevington and D. Keith Robinson, McGraw Hill

Description and Assessment of Assignments
Assignments will be in the form of weekly problem sets which will require the students to create and run MATLAB scripts related to the topics discussed during the week’s lecture.

Grading Breakdown

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Points</th>
<th>% of Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem sets</td>
<td>15 x 100pts</td>
<td>90%</td>
</tr>
<tr>
<td>Participation</td>
<td>15</td>
<td>10%</td>
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</tbody>
</table>
Assignment Submission Policy
Problem sets must be submitted by Monday at midnight (11:59 pm PST). Maximum credit will be reduced by 10% for every day the assignment is late unless the student has obtained prior approval from the instructor.

Course Schedule: A Weekly Breakdown

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics/Daily Activities</th>
<th>Readings and Homework</th>
<th>Deliverable/ Due Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/14</td>
<td>Introduction to MATLAB and basic linear algebra</td>
<td>Ch. 1</td>
<td>Problem Set #1</td>
</tr>
<tr>
<td>2</td>
<td>1/21</td>
<td>Probability distributions, error propagation, and statistical tests</td>
<td>Ch. 2</td>
<td>Problem Set #2</td>
</tr>
<tr>
<td>3</td>
<td>1/28</td>
<td>Regression techniques</td>
<td>Ch. 3</td>
<td>Problem Set #3</td>
</tr>
<tr>
<td>4</td>
<td>2/4</td>
<td>Principal component analysis</td>
<td>Ch. 4</td>
<td>Problem Set #4</td>
</tr>
<tr>
<td>5</td>
<td>2/11</td>
<td>ODE and 0D box models</td>
<td>Ch. 8</td>
<td>Problem Set #5</td>
</tr>
<tr>
<td>6</td>
<td>2/18</td>
<td>0D model: marine ecosystems</td>
<td>Ch. 9</td>
<td>Problem Set #6</td>
</tr>
<tr>
<td>7</td>
<td>2/25</td>
<td>Model analysis</td>
<td>Ch. 10</td>
<td>Problem Set #7</td>
</tr>
<tr>
<td>8</td>
<td>3/4</td>
<td>Advection, diffusion, and turbulence</td>
<td>Ch. 11</td>
<td>Problem Set #8</td>
</tr>
<tr>
<td>9</td>
<td>3/11</td>
<td>Finite difference techniques</td>
<td>Ch. 12</td>
<td>Problem Set #9</td>
</tr>
<tr>
<td>10</td>
<td>3/25</td>
<td>1D model: advection-diffusion</td>
<td>Ch. 13</td>
<td>Problem Set #10</td>
</tr>
<tr>
<td>11</td>
<td>4/1</td>
<td>1D model: sediments</td>
<td>Ch. 14</td>
<td>Problem Set #11</td>
</tr>
<tr>
<td>12</td>
<td>4/8</td>
<td>1D model: seasonal cycle</td>
<td>Ch. 15</td>
<td>Problem Set #12</td>
</tr>
<tr>
<td>13</td>
<td>4/15</td>
<td>2D model: ocean gyres</td>
<td>Ch. 16</td>
<td>Problem Set #13</td>
</tr>
<tr>
<td>14</td>
<td>4/22</td>
<td>3D models: GCMs</td>
<td>Ch. 17</td>
<td>Problem Set #14</td>
</tr>
<tr>
<td>15</td>
<td>4/29</td>
<td>Scientific Visualization</td>
<td>Ch. 19</td>
<td>Problem Set #15</td>
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Statement on Academic Conduct and Support Systems

Academic Conduct
Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in Scampus in Section 11, Behavior Violating University Standards https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/. Other forms of academic dishonesty are equally unacceptable. See additional information in Scampus and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct/.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity http://equity.usc.edu/ or to the Department of Public Safety http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Support Systems
A number of USC’s schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the American Language Institute http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. The Office of Disability Services and Programs http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, USC Emergency Information http://emergency.usc.edu/ will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.