Syllabus for Math 399, *Tutorial in Numerical Methods and Mathematical Computing*

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Fall 2021

1 Basic Information

**Classes meet.** Tentatively Tuesday and Thursday 3:00–4:15

**Professor.** Dr. Brenton LeMesurier

**Professor’s Office hours.** To be arranged during the first week of classes.

**Professor’s Office.** Room 344, Robert S. Small Building

**Professor’s Email Address.** lemesurierb@cofc.edu

**Professor’s Office Phone.** 953-5917, messages 953-5730.

**Professor’s Website.** [http://blogs.cofc.edu/lemesurierb/](http://blogs.cofc.edu/lemesurierb/), but most online communication will be provided through OAKS.

**Materials.** The main materials are an HTML-format Jupyter Book and a collection of related Jupyter notebooks. Thus there is no text that it unnecessary to buy; however, I can suggest several reference books and online sources, and the course notebooks will give references to those for supplementary reading.

I also provide another Jupyter Book, *Python for Scientific Computing*, which might be useful for review of Python and learning some topics possibly not covered in CSCI 220 and 220L, such as Numpy arrays and Matplotlib graphics.

2 Course Objectives and Student Learning Outcomes

The main expectation of this course is that students learn methods for computing accurate numerical solutions to mathematical and scientific problems, and acquire an understanding of when and why particular methods work, and how reliable, accurate and efficient they are. The first main topic is a review of Taylor polynomials, which are a basic tool in numerical computation because they allow the approximation of many functions by
polynomials, which are easy to work with. Then we consider general issues of how to describe and measure the accuracy of numerical solutions, and sources of inaccuracy such as rounding in arithmetic. We will see methods for numerically solving problems such as nonlinear equations, systems of simultaneous equations, approximating functions by polynomials, fitting straight lines and simple curves to experimental data, and approximating derivatives and definite integrals: mainly from Chapters 1 to 5 of the textbook, but not all sections of each chapter. We will also look briefly at solving differential equations (Chapter 10), to preview an important topic that you are likely to see in later courses.

3 Course Objectives

- To review some useful calculus topics, in particular the Intermediate Value Theorem and Taylor’s Theorem.
- To learn the accuracy and limitations of standard IEEE64 computer arithmetic and the effects of rounding.
- To compute numerical approximate solutions of equations in one variable by the bisection method, fixed point iteration, Newton’s method, the secant method, and some refinements.
- To numerically solve system of simultaneous linear equations and assess the effects of rounding error on the accuracy of the results;
- To fit polynomials to data by exact interpolation and least squares approximation;
- To approximate functions by polynomials, and use this to approximate derivatives and definite integrals;
- To compute numerical approximate solutions of initial value problems for ordinary differential equations.

4 Software

The main tools for computation will be Python with the packages NumPy (providing extra numerical computing resources) and Matplotlib (for graphics). These will mostly be used within Jupyter notebooks, which provide a “literate programming” environment for combining Python code and its output with explanatory text and mathematical material.

Some students might also wish to use an Integrated Development Environment [IDE] such as Spyder which offers more sophisticated code editing and debugging tools.

This can all be accessed on your own computers using the free software bundle Anaconda (Individual Edition). If working only with notebooks, another option is using the browser-based Colaboratory system at https://colab.research.google.com/

5 Graded Work and Grading Scheme

5.1 Assignments

There will be assignments every two weeks, combining Python coding exercises and some mathematical exercises and discussion. Most work will be presented as Jupyter notebooks (or if you wish, as a Jupyter Book).
5.2 Projects

There will be several projects, similar to assignments but more substantial. The topics will be decided in
discussion with enrolled students; if there is more that student, some or all of the topics may individually
chosen. (I will also provide a list of suggested projects and other sample topics.)

5.3 Grading Scheme

The total grade will be weighted 40% on the assignment total, 60% on the projects.
The aggregate score guarantees at least the following grades:

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<thead>
<tr>
<th>Grade</th>
<th>Score Range</th>
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<tbody>
<tr>
<td>A</td>
<td>90–100</td>
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<tr>
<td>A−</td>
<td>87–89</td>
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<tr>
<td>B+</td>
<td>84–86</td>
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<tr>
<td>B</td>
<td>80–83</td>
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<td>B−</td>
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<td>C+</td>
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<td>C−</td>
<td>67–69</td>
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<td>D+</td>
<td>64–66</td>
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<tr>
<td>D</td>
<td>60–63</td>
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<td>D−</td>
<td>57–59</td>
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6 Accommodations for Students with Disabilities

If you have a documented disability, please contact me during the first two weeks of class or as soon as
you have been approved to receive accommodations, so that reasonable accommodations can be arranged.
Approval for such accommodations is arranged through the Center for Disability Services: see http://disabilityservices.cofc.edu/accommodations/

7 College of Charleston Honor Code and Academic Integrity

Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified,
are investigated. Each incident will be examined to determine the degree of deception involved.
Cases of suspected academic dishonesty will be reported directly to the Dean of Students. A student found
responsible by the Honor Board for academic dishonesty will receive a XXF in the course, indicating failure
of the course due to academic dishonesty. This grade will appear on the student’s transcript for two years
after which the student may petition for the XX to be expunged. The F is permanent. The student may also
be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from
the College by the Honor Board.

Students should be aware that unauthorized collaboration or working together without permission is a form
of cheating. Unless the instructor specifies that students can work together on an assignment, quiz and/or
test, no collaboration during the completion of the assignment is permitted. Other forms of cheating include
possessing or using an unauthorized study aid (which could include accessing information via a cell phone
or computer), copying from others’ exams, fabricating data, and giving unauthorized assistance.

Students can find the complete Honor Code and all related processes in the Student Handbook at http://studentaffairs.cofc.edu/honor-system/studenthandbook/

8 Some Important Dates and Times

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>Mon. &amp; Tue., Oct. 18</td>
<td>Fall Break—no classes.</td>
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<tr>
<td>Wed. Nov. 24 – 28</td>
<td>Thanksgiving Break—College closed; no classes.</td>
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<tr>
<td>Monday Dec. 6</td>
<td>Last day of classes.</td>
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