MATH 616-010   Modeling in Applied Mathematics
MWF 9:05–9:55, PRN 235   Fall 2021
        Web Page: `http://www.math.udel.edu/~edwards/download/m616/f21home.html`
                    (also referenced from QR code at end of document)

Instructor: Prof. D. A. Edwards   Office Hours: T 1:30–2:30, F 11:15–12:15 or by appointment
EWG 511   x1871, `dedwards@udel.edu`

Introduction

Welcome to MATH 616! In this course you will be learning not only the techniques used in applied mathematics, but also how they are actually used in practice to analyze physical systems. The text for this course is *Applied Mathematics*, 4th ed., by Logan. In addition, upon request I will put other books on reserve in the Morris Library that may prove helpful for certain sections.

If you have a problem, question about the material, or interesting application you would like me to address in class, please feel free to contact me during my office hours or make an appointment. **Extra copies of handouts are available at the Web page listed above.**

If you have to miss class one day, just get the notes from someone. If you are in quarantine, let me know and I will stream the class over Zoom.

Please silence cellular phones before entering the classroom.

Electronic Communication

The Web page for this course is listed above: there you will find copies of handouts available for downloading. Important announcements (corrections to typographical errors, etc.) will be handled by e-mail. Also at the URL

`http://www.math.udel.edu/~edwards/download/suggest.html`

you will find an anonymous suggestion box.

Homework

The most effective way to succeed in this course is to do all the homework assignments. I select the problems carefully to illustrate the most important topics in the course. Even if you are registered as a listener, I recommend doing the homework, and I will review it.

In most cases, homework will be distributed every Wednesday during lecture. and it will be due at the beginning of class the following Wednesday. (The first homework assignment is attached to this sheet.) The homework will ideally cover material up through the Friday after it is distributed. **ABSOLUTELY NO LATE HOMEWORK WILL BE ACCEPTED!** If you must miss a due date because of University business, it is your responsibility to make sure the homework gets to me *before* the due date. Since mathematics is a subject where the material for one section builds on the section before, it is critical that you keep up to date on the homework: hence the stringent policy. However, to calculate your semester-long homework average, I will drop your two lowest homework scores. Therefore, low scores for assignments where you were pressed for time can be erased as long as you don't have too many of them.

Though you may not copy directly from another's paper or use someone else's ideas (including online aids) as your own[1], I encourage you to discuss the homework problems with your classmates. Any scientific endeavor is rarely done in a vacuum; therefore it is to your advantage to learn the benefits of collaborating. Model homework solutions will be posted online after the assignment is due. Hopefully these will assist you in learning the material.

Homework assignments should be folded like a book with the following information on the "front cover:"

<div align="center">

Name
MATH 616—Edwards
Assignment Number
Date

</div>

You will turn in your assignments this way so that I can put your grade on the inside, thus ensuring your privacy. I will make every effort to ensure that your graded homework is returned in a timely manner. The number of points assigned to each problem will be listed.

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[1] For more details regarding academic dishonesty, see the Student Handbook (`http://www.udel.edu/stuguide/`).

Exams

There will be a midterm and final exam for the course; the dates are listed on the attached schedule. **You will need a small blue book for each exam**. Attached to each examination will be a course evaluation form so that I may receive your suggestions for how the course could be improved. These forms will be seen only by me, so if you have comments that you wish the department to hear, please contact them directly.

When the exams are returned, they will have a numerical score and a letter grade on them. The numerical score is your score for the exam; *the letter grade is your grade for the course* to that point, including all homework scores.

Writing Assignment

As each of you proceeds in your career, you will encounter situations where you will have to communicate your ideas to others. Those in academia have to submit theses and research articles; those in industry must make presentations and write reports. In order to prepare you for this sometimes daunting task, I am assigning a **MANDATORY** writing assignment. In it, you will choose a phenomenon which interests you, create a simple model to describe it, and then solve the equations governing the model using the techniques you have learned in this class. The focus of the assignment will be the clarity of the expression contained therein, rather than the mathematical sophistication of the arguments. Further details will follow.

Assessment

Your grade for the course will be determined in two stages. First your *raw score* will be calculated using the *higher* of the two algorithms:

1) Each exam will count for 1/3 of your grade; the other 1/3 will be split between the homework and the writing assignment.
2) The writing assignment will count for 1/6 of your grade; the other 5/6 will be split evenly between the homework and exams.

Then each of the raw scores will be scaled to determine final grades, if necessary.

<u>Tentative Schedule</u>

Note: This is only a tentative schedule; there may be deviations from it.

week of August 30: modeling, scaling
   September 1: Homework 1 distributed
week of September 3: scaling, dimensional analysis, population dynamics
September 7: Labor Day (no lecture)
week of September 13: population dynamics, linear and nonlinear phase planes
   September 15: Homework 1 due; Homework 2 distributed
week of September 20: nonlinear phase planes, predator-prey systems
   September 22: Homework 2 due; Homework 3 distributed
week of September 27: predator-prey and epidemic systems, one-dimensional discrete models
   September 27: Topic for writing assignment due
   September 29: Homework 3 due; Homework 4 distributed
week of October 4: one- and two-dimensional discrete models
   October 6: Homework 4 due; Homework 5 distributed
week of October 11: two-dimensional discrete models, stochastic models
October 15: No lecture
week of October 18: the diffusion equation, the Stefan problem, traveling waves
   October 20: Homework 5 due; Homework 6 distributed
week of October 25: traveling waves, first-order PDEs
   October 25: Outline of writing assignment due
   October 27: Midterm exam distributed
week of November 1: first-order PDEs
   November 3: Homework 6 due; Homework 7 distributed
week of November 8: shocks, the wave and Navier-Stokes equations
   November 10: Homework 7 due; Homework 8 distributed
week of November 15: Navier-Stokes, bifurcation theory, variational principles
   November 17: Homework 8 due; Homework 9 distributed
week of November 22: Thanksgiving break (no lecture)
week of November 29: variational principles, Volterra equations
   November 29: Writing assignment due
December 6: Volterra equations
December 8: review
   December 8: Homework 9 due; supplemental study material distributed