APMA 1070 – Quantitative Models of Biological Systems

Fall semester, 2016

Instructor:
Anastasios Matzavinos

Office:
Room 325, 182 George Street

Class meeting times:
MWF 10:00 am – 10:50 am, B&H 157

Office hours:
MWF 11:00 am – noon
(or by appointment)

Class web page:
https://canvas.brown.edu/courses/1070337

Announcements and other information about the class will be posted regularly on the class web page.

Course description:

APMA 1070 is focused on mathematical modeling in the biological and biomedical sciences. This is a fascinating and highly interdisciplinary topic with ties to various active areas of research.

Topics covered include deterministic and stochastic approaches to biochemical networks, enzyme kinetics, protein-protein interaction networks, population genetics, evolutionary game theory, infectious diseases and epidemics on networks, biological invasions, reaction-diffusion systems, and mechanisms of pattern formation in developmental biology.

Occasionally, we may also discuss certain mathematical and computational models from systems physiology and pharmacokinetics, depending on the interests of the class.

The course will build upon and develop several mathematical and computational topics in tandem with the biological applications covered. Such mathematical topics will include dynamical systems, probability and Markov chains, game theory, elements of network science, and scientific computations using MATLAB. Prior exposure to any of these topics is not required.

Prerequisites: APMA 0330, 0340 or 0350, 0360, or written permission.

Course objectives:

Upon successful completion of this class, students will have a working understanding of the process of mathematical modeling in the biological sciences, and they will be able to demonstrate the following competencies: (i) an ability to identify questions regarding biological processes that can be addressed through mathematical modeling, (ii) knowledge of current technology in the field of mathematical biology, and (iii) an ability to develop and evaluate mathematical models of biological systems.

Credit hours:

Total time spent in and out of class for this course is estimated at ~180 hours. Over the 13 weeks of this course, students will spend 3 hours in class each week, or 39 hours total. Although specific out-of-class time investments may vary for individual students, a

reasonable estimate to support this course's learning outcomes is 141 total out-of class hours, or on average, 11 hours weekly over a 13-week term. Out-of-class preparation will regularly include about 3 hours per week of reading (39 hours total). In addition to this ongoing preparation time, students are expected to allocate approximately 52 hours over the course of the term to completing assignments, 20 hours to preparation for the midterm exam, and 30 hours for the final project.

Required text:

The following textbook is required reading for APMA 1070.

- A Primer on Mathematical Models in Biology by Lee A. Segel and Leah Edelstein-Keshet. Society for Industrial and Applied Mathematics, 2013. (~$70).

Other useful references:

The following references do not constitute required reading. However, they provide useful discussions of some of the more advanced material that will be covered in class. Brown University students can access these textbooks for free on the publisher's web page.

- Mathematical Modeling of Biological Processes by Avner Friedman and Chiu-Yen Kao. Springer, 2014.
- Parabolic Equations in Biology: Growth, Reaction, Movement, and Diffusion by Benoît Perthame. Springer, 2015.

Grading policy:

The final grade will be based on homework assignments, a take-home midterm exam (see below for dates) and a final project:

Homework assignments	**30%**
Midterm exam	**30%**
Final project	**40%**

Homework assignments:

Homework problems will be handed out on a regular basis. Discussion of homework assignments with other students is encouraged, but what is handed in should be your own work.

Important dates:

Take-home midterm exam	**Friday, October 21**
Final project due date	**Tuesday, December 20**

Accommodations and other considerations:

Brown University is committed to full inclusion of all students. Please inform me early in the term if you have a disability or other conditions that might require accommodations or modification of any of these course procedures. You may speak with me after class or during office hours. For more information, please contact Student and Employee Accessibility Services at 401-863-9588 or SEAS@brown.edu.

Students in need of short-term academic advice or support can contact one of the deans in the Dean of the College office.