MAT 6932: Seminar in Biomath, Fall 2022

Location: LIT 207
Time: MWF, 1:55-2:45

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Office hours: MW, 10:40 – 11:30 or by appointment

Course Objective and Description: To introduce students to mathematical models that describe and study virus dynamics and theoretical immunology. Mathematical models (systems of ordinary, delay, and partial differential equations) will be introduced to the study of various virus infections (HIV, hepatitis, influenza, etc), drug treatment, and immune responses. Model prediction will be compared with experimental data for validation. Mathematical analysis, numerical simulation, and data analysis methods such as data fitting and parameter estimates will be discussed.

Prerequisite: There is no explicit prerequisite for this seminar course but basic knowledge of differential equations, linear algebra, and numerical methods will be useful. Prior knowledge of virology and immunology is not necessary. If students have concerns about the prerequisite, please contact the instructor.

Attendance: Class attendance is expected.

Homework: There will be occasional homework after some lectures. Homework will be collected and graded.

Project: Students are expected to read papers that expand the topics of lectures, make a computer-based presentation, and write a final report. They can make presentations on virus dynamics or theoretical immunology (i.e. within-host dynamics), or more broadly, on mathematical epidemiology or ecology. Ideally, students can develop and analyze a new model that improves the published one. The instructor can also assign papers to students for the project if needed.

The presentation/report may include: the background of the biological question, motivation of the study, model formulation, analytical results of the model, numerical simulations of the model, and biological/medical implications. The final report is based on the presentation but can include more details.

Grades: Grades will be based on attendance, homework, and project.

References: Students don't have to buy any books but the following will be good references for this course.

Lecture notes

Articles that will be sent to students before class

Virus Dynamics: Mathematical Principles of Immunology and Virology, by Martin Nowak and Robert May, Oxford University Press, 2000

Killer Cell Dynamics: Mathematical and Computational Approaches to Immunology, by Dominik Wodarz, Springer, 2007

Theoretical Immunology, by Rob de Boer, online at bioinformatics.bio.uu.nl/rdb/books/ti.pdf

How the Immune System Works, by Lauren Sompayrac, Wiley Blackwell, 5th Edition, 2016 (If students are interested in learning more immunology, they can start with this short book, which provides an overview of how the immune system fits together to fight against infectious diseases.)