EPIDEMIOLOGY 814

Topics in Epidemiological Analysis: Advanced Modeling Methods

Mondays and Wednesdays, 1-2:30pm in 1123 SPH II

Instructor
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Office Hours: After class or by appointment

Course Description:	This course is intended to be a broad topics course, exploring different methods and approaches to mathematical modeling, data visualization, data analysis, and computation, in the context of public health. Topics may vary year to year depending on the interests and focus of the class, but may include:

- Parameter estimation with complex systems models (maximum likelihood, Bayesian approaches and MCMC, uncertainty and identifiability)
- Approaches to determining the basic reproduction number (e.g. data-driven methods, the next generation matrix, type and target reproduction numbers)
- Links between complex systems models, DAGs, and causal inference
- Data visualization methods (e.g. ggplot, mapping spatial data)
- API's and scraping data from social media (e.g. Twitter)
- Shiny apps and interactives
- And other methods, such as network analysis, time series analysis methods, stochastic modeling approaches, basic clustering and classifiers, and parallelization of code

Course Website:	https://epimath.org/epid-814-materials/
Pre-requisites:	There are no official prerequisites, however students are assumed to have previous exposure to mathematical modeling and be comfortable both with programming and with implementing most common model types (e.g. compartmental models such as an SIR model).
Course Goals:	By the end of the course, students should have an expanded repertoire of complex systems modeling and computational approaches they can use. They should be able to identify research questions that can be addressed with various modeling and computational methods, discuss the practical applications of these methods, and the role of modeling in public health policy. We particularly focus on CEPH Learning Objective 3: Explain the role of quantitative and qualitative methods and sciences in describing and assessing a population's health.
Competencies:	This course addresses the following Epidemiology MPH Competencies: 1. Apply epidemiological methods to the breadth of settings and situations in

public health practice
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate
4. Interpret results of data analysis for public health research, policy or practice
18. Select communication strategies for different audiences and sectors
19. Communicate audience-appropriate public health content, both in writing and through oral presentation
22. Apply systems thinking tools to a public health issue

Course Requirements: Class Participation – 40%
Homework/Labs – 20%
Journal club discussion – 40%

Classroom Expectations/Format:
The course will consist of a mix of lectures, computational labs, and journal club discussions (where a paper covering a topic of interest is discussed together)

Diversity, Equity, and Inclusion:
The University of Michigan School of Public Health seeks to create and disseminate knowledge, with the aim of preventing disease and promoting the health of populations worldwide. We commit to create an environment to foster relationships within and beyond the School of Public Health that promote community connection. Utilizing the institutional civility code we will promote the values of diversity, equity, and inclusion, both inside and outside our classrooms. To this end, SPH upholds the expectations that all course participants will acknowledge diverse experiences in the classroom, create environments that encourage equitable classroom participation, and ensure that students and faculty abide by UM policies and procedures.

Academic Integrity:
The faculty and staff of the School of Public Health believe that the conduct of a student registered or taking courses in the School should be consistent with that of a professional person. Courtesy, honesty, and respect should be shown by students toward faculty members, guest lecturers, administrative support staff, community partners, and fellow students. Similarly, students should expect faculty to treat them fairly, showing respect for their ideas and opinions and striving to help them achieve maximum benefits from their experience in the School.

Student academic misconduct refers to behavior that may include plagiarism, cheating, fabrication, falsification of records or official documents, intentional misuse of equipment or materials (including library materials), and aiding and abetting the perpetration of such acts. Please visit https://sph.umich.edu/student-resources/mph-mhsa.html for the full Policy on Student Academic Conduct Standards and Procedures.

SPH Writing Lab:
The SPH Writing Lab is located in 5025 SPH II and offers writing support to all SPH students for course papers, manuscripts, grant proposals, dissertations, personal statements, and all other academic writing tasks. The Lab can also help answer questions on academic integrity. To learn more or make an appointment, please visit the SPH writing lab website.

Student Well-Being:

SPH faculty and staff believe it is important to support the physical and emotional well-being of our students. If you have a physical or mental health issue that is affecting your performance or participation in any course, and/or if you need help connecting with University services, please contact the instructor or the SPH Office for Student Engagement and Practice. Please visit https://sph.umich.edu/student-life/wellness.html for information on wellness resources available to you.

Student Accommodations:

Students should speak with their instructors before or during the first week of classes regarding any special needs. Students can also visit the SPH Office for Student Engagement and Practice for assistance in coordinating communications around accommodations. Students seeking academic accommodations should register with Services for Students with Disabilities (SSD). SSD arranges reasonable and appropriate academic accommodations for students with disabilities. Please visit https://ssd.umich.edu/topic/our-services for more information on student accommodations.

Students who expect to miss classes, examinations, or other assignments as a consequence of their religious observance shall be provided with a reasonable alternative opportunity to complete such academic responsibilities. It is the obligation of students to provide faculty with reasonable notice of the dates of religious holidays on which they will be absent. Please visit http://www.provost.umich.edu/calendar/ for the complete University policy.

Course Topics/Reading List:

For course topics, please see course description above. Readings will be provided by the instructor, but for some good introductory texts on modeling, I would recommend:

Joseph J. DiStefano III. *Dynamic Systems Biology Modeling and Simulation.* Academic Press, 2014.

Introduction to the Modeling and Analysis of Complex Systems by Hiroki Sayama (http://textbooks.opensuny.org/introduction-to-the-modeling-and-analysis-of-complex-systems/)

Emilia Vynnycky, Richard White. *An Introduction to Infectious Disease Modelling*. Oxford University Press, 2010

Robert Smith?. *Modelling Disease Ecology with Mathematics*. American Institute of Mathematical Sciences, 2008.

Matt J. Keeling, Pejman Rohani. *Modeling Infectious Diseases in Humans and Animals*. Princeton University Press, 2007.

Keener and Sneyd. *Mathematical Physiology.* Springer, 2009