Course Title: VTPMD 6665 - Novel Methods in Epidemiology

Semester: Spring
Room: Schurman Hall S1-106
Class meeting times:
Lecture: M, W: 12:20 pm – 1:10 pm
Laboratory: M, W: 1:25 pm – 2:15 pm
Grading: S/U or Letter grade
Credit Hours: 3 Hours
Lead instructor: Dr. Renata Ivanek-Miojevic
E-mail: ri25@cornell.edu
Office: S1-026 Schurman Hall
Cell phone: 607-216-2716
Office hours: After class or by appointment
Teaching Assistant: TBN

I. Rationale:

The goal of this team-taught course is to introduce students to novel methods in the investigation of epidemiologic concepts and determinants of health or disease in populations. The course consists of short modules, each lasting 1-1.5 weeks, covering cutting-edge methods used in various subfields of epidemiology.

II. Course Aims and Outcomes:

Aims: This interdisciplinary course aims to equip students with a foundational understanding of innovative methods used in modern epidemiologic research. Through a series of focused modules, students will explore advanced techniques across diverse subfields of epidemiology, such as molecular epidemiology, mathematical modeling, hybrid study designs, animal health economics, risk assessment, machine learning, diagnostic methods, clinical trials, and social science applications. By the end of the course, students will be able to:

- Describe and compare emerging methodologies in epidemiologic research.
- Apply selected analytical tools to investigate determinants of health and disease.
- Critically evaluate the strengths and limitations of various methodological approaches.
- Communicate findings effectively across scientific and policy-making audiences.

Pre-requisites: VTPMD 6640, VTPMD 6660, BTRY 6010, and BTRY 6020; or permission of the lead instructor. Students who are interested in the course but have not completed the prerequisites should contact the lead instructor (ri25@cornell.edu) to request permission to enroll. If permission is granted, it should be viewed as an opportunity—not a substitute for academic preparation. Students admitted without the listed prerequisites are expected to take full responsibility for their learning by ensuring they have the necessary background and committing themselves to the coursework. Ultimately, a passing grade will be based on demonstrated mastery of the course material through assignments, regardless of the method of enrollment.

Specific Learning Outcomes for individual modules:

Instructor (email)	Module name	Length (weeks)	Learning objectives:
Renata Ivanek (ri25@cornell.edu)	Risk assessment	1	1. Understand the fundamentals of risk assessment (risk vs hazard, uncertainty vs variability, risk assessment steps, simulation) 2. Learn to use R for risk assessment 3. Conduct a simplified risk assessment and interpret findings
Ana Bento (arb24@cornell.edu)	Mathematical modeling of infectious diseases	1	1. Explain the purpose and scope of mathematical models in epidemiology 2. Define key epidemiological terms (e.g., susceptible, infected, recovered) 3. Describe main model types and interpret simple compartment models 4. Construct the SIR model equations and diagram 5. Define basic reproduction number 6. Extend the SIR model (e.g., with vital dynamics, latency, vaccination) 7. Link models to empirical data and discuss potential challenges
Renata Ivanek (ri25@cornell.edu)	Literature screening with semi-automated active learning tools	0.5	1. Understand the steps in the systematic review of literature 2. Learn to use semi-automated active learning in the ASReview LAB for article screening as part of a systematic review
Cassandra Guarino (cg82@cornell.edu)	Diagnostic methods & interpretation of test results	1	1. Describe standard methods for identifying microorganisms 2. Understand the use of Fourier-transformed infrared (FTIR) spectroscopy in microbiology 3. Implement machine learning to develop a classifier to identify species variants
Taika von Konigslow (taika.vk@cornell.edu)	Controlled trials and sensor data	1.5	1. Understand the fundamentals of controlled trials 2. Describe how to select and validate sensor technologies 3. Identify the strengths, limitations, and practical requirements for collecting and analyzing multi-modal data
Laura Goodman (laura.goodman@cornell.edu)	Molecular epidemiology	1.5	1. Compare and contrast genomic sequencing approaches used for humans vs. microbes 2. Compare subtyping strategies for different microbes/pathogens 3. Understand how phylogenetic inference is used in infectious disease epidemiology
Casey Cazer (casey.cazer@cornell.edu)	Machine learning in epidemiology	1	1. Select an appropriate type of machine learning model for a specific research question and data types 2. Apply and interpret a supervised machine learning model to answer an epidemiology research question 3. Apply and interpret an unsupervised machine learning model to answer an epidemiology research question
Matthew MacLachlan (mjm756@cornell.edu)	Economics in epidemiology	1.5	1. Defining measurable economic consequences of diseases and costs of disease monitoring and control 2. Economic analysis (e.g., cost-benefit analysis, partial budgeting) 3. Application of machine learning for economic predictions
Amandine Gamble (amandine.gamble@cornell.edu)	Navigating field research: Study design & analysis under challenging field conditions	1	1. Understand the impact of imperfect diagnostics/detection on epidemiological metrics 2. Account for imperfect diagnostics/detection and integrate several data sources with occupancy models 3. Apply and interpret occupancy models to real-world data using R
Kevin Cummings (kjc39@cornell.edu)	Hybrid study designs	1	1. Describe the key features and appropriate use of various hybrid study designs 2. Characterize the strengths and limitations of these hybrid study designs
Amelia Greiner Safi (alg52@cornell.edu)	Social and qualitative epidemiology	1	1. Describe key theories of human behavior 2. Identify and explain 1) social, environmental, and political impacts on human/animal health and 2) how these multilevel influences affect disease distribution, severity, and prevention 3. Describe how qualitative methods may enhance understanding of disease causation, distribution, and prevention
Alistair Hayden (ath79@cornell.edu)	Spatial maps of health-related data	1	1. Apply basic technical mapping skills to map health-related data 2. Apply basic map-design skills

III. Format, Requirements and Grading:

Format: This is an intensive, team-taught advanced-level graduate course in epidemiology methods. The course will be delivered through multiple modules, each including lectures and laboratory classes. As part of the learning process, students may score homework or quizzes of fellow students. Attendance at lectures and laboratories is expected.

Required text: TBA

Course requirements: Access to Canvas and the Internet are required. Canvas is a web-based course management system that aids management of course materials, assignments, communications, and other aspects of instruction. It will be your responsibility to check this site regularly for course-related announcements. **Students will be required to use their personal laptops/computers in laboratory class meetings.** Students unable to comply with this requirement should contact Dr. Ivanek at the start of the semester.

Additional resources: TBA

Grading policy: For all students, the grade or S/U for this course will be based on the quizzes and homework.

***Quizzes*:** Prior to coming to the lecture/lab you will be expected to read pertinent class material. For any missed quiz, you will write a page-long essay about the assigned reading; there will be no make-up quizzes except if your absence was excused (http://courses.cornell.edu/content.php?catoid=12&navoid=2089). A single quiz in which you got the lowest score during the semester will not be counted in your grade. You will submit your quiz via Canvas (or as a hard copy or via e-mail to the module instructor if so instructed).

***Homework*:** Unless specified otherwise, assigned homework will be due a week from the day of assignment. Late homework will be marked down by 10% per day except if the delay is due to an excused absence (http://courses.cornell.edu/content.php?catoid=12&navoid=2089). Homework may involve writing a short essay, and/or conducting analyses using software or by hand. You will submit your homework via Canvas (or as a hard copy or via e-mail to the module instructor if so instructed).

***Grading*:**

- Quizzes = 30%
- Homework = 70%

Grading scale:

Percent	Letter	Grade Point Value
100+	A+	4.3
97-100	A	4
92-96	A-	3.7
88-91	B+	3.3
85-87	B	3
82-84	B-	2.7
79-81	C+	2.3
76-78	C	2
73-75	C-	1.7
70-72	D+	1.3
67-69	D	1
61-66	D-	0.7
0-60	F	0

IV. Tentative course schedule*:

Week	Date	Instructor	Module name	Module notation	Quiz	Homework (HW) due:
1						
1	21-Jan	Ivanek	Risk assessment	M1	M1	
2	26-Jan	Ivanek	Risk assessment	M1	M1	
2	28-Jan	Bento	Mathematical modeling of infectious diseases	M2		
3	2-Feb	Bento	Mathematical modeling of infectious diseases	M2	M2	M1
3	4-Feb	Ivanek	Literature screening with semi-automated active learning tools	M12		
4	9-Feb	Guarino	Diagnostic methods & interpretation of test results	M3		
4	11-Feb	Guarino	Diagnostic methods & interpretation of test results	M3	M3	M2
5	**16-Feb**		Feb break			
5	18-Feb	von Konigslow	Controlled trials and sensor data	M4		
6	23-Feb	von Konigslow	Controlled trials and sensor data	M4	M4	M3
6	25-Feb	von Konigslow	Controlled trials and sensor data	M4	M4	
7	2-Mar	Goodman	Molecular epidemiology	M5		
7	4-Mar	Goodman	Molecular epidemiology	M5	M5	M4
8	9-Mar	Goodman	Molecular epidemiology	M5	M5	
8	11-Mar	Cazer	Machine learning in epidemiology	M6		
9	16-Mar	Cazer	Machine learning in epidemiology	M6	M6	M5
9	18-Mar	MacLachlan	Economics in epidemiology	M7		
10	23-Mar	MacLachlan	Economics in epidemiology	M7	M7	M6
10	25-Mar	MacLachlan	Economics in epidemiology	M7	M7	
11	**30-Mar**		Spring break			
11	**1-Apr**		Spring break			
12	6-Apr	Gamble	Navigating field research	M8		M7
12	8-Apr	Gamble	Navigating field research	M8	M8	
13	13-Apr	Cummings	Hybrid study designs	M9		
13	15-Apr	Cummings	Hybrid study designs	M9	M9	M8
14	20-Apr	Greiner Safi	Social and qualitative epidemiology	M10		
14	22-Apr	Greiner Safi	Social and qualitative epidemiology	M10	M10	M9
15	27-Apr	Hayden	Spatial maps of health-related data	M11		
15	29-Apr	Hayden	Spatial maps of health-related data	M11	M11	M10
16	4-May	TBD	Backup class	TBD		
16	6-May		No instruction			M11

**Subject to change to accommodate students' learning process*

V. Academic Integrity

Each student in this course is expected to abide by the Cornell University Code of Academic Integrity. Any work submitted by a student in this course for academic credit will be the student's own work. You are encouraged to study together and discuss the information and concepts covered in the lecture and laboratory sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an email, an email attachment file, a USB drive, a hard copy, or a similar medium. Should copying occur, both the student who copied work from another student and the student who provided the material to be copied will automatically receive a zero for the assignment. Penalties for violating this Code can also include failure of the course and University disciplinary action. During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examination will result in failure of the exam and may lead to failure of the course, as well as University disciplinary action.

VI. Accommodations for students with disabilities

In compliance with Cornell University policy and equal access laws, I am available to discuss appropriate academic accommodations that may be required for students with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances, so arrangements can be made. Students are encouraged to register with Student Disability Services to verify their eligibility for appropriate accommodations.

VII. Inclusivity Statement

The College of Veterinary Medicine is dedicated to creating an environment that promotes learning and mutual respect. While working together to build this community, we ask all members to:

- share their unique experiences, values, and beliefs
- be open to the views of others
- honor the uniqueness of their colleagues
- appreciate the opportunity that we have to learn from each other in this community
- value each other’s opinions and communicate in a respectful manner
- keep confidential discussions that the community has of a personal (or professional) nature
- use this opportunity together to discuss ways in which we can create a welcoming environment in this course and across the Cornell community

We look forward to getting to know each of you and working with you as we achieve the learning outcomes in this course.