Modeling Transmission Processes and Control of Infectious Diseases in Humans and Animals

Course Number:	8830	**Course Type:**	Elective
Credit Hours:	3.00	**Semester and Year:**	Autumn 2017

Course Description:
Intensive course that provides an introduction to computer models of infectious diseases and their applications. Includes lecture and laboratory and focuses on applications rather than mathematical theory.

Team Leader Contact Information

Dr. Rebecca Garabed

Phone Number: -
Email: garabed.1@osu.edu

Team Members

Name	Position	Phone	Email	Office	Subject Area / Role in the Course
Dr. Rebecca Garabed	Associate Professor	-	garabed.1@osu.edu	A100G Sisson Hall	Practical Disease Considerations
Dr. Andrew Calinger-Yoak	Assistant Professor	-	yoak1@otterbein.edu	Otterbein University	Agent-Based Models
Ms Sarah Mielke	Graduate Research Associate		mielke.153@osu.edu	A100Z Sisson Hall	Agent-Based Models and Discussion Leader
Dr. Laura Pomeroy	Assistant Professor	-	pomeroy.26@osu.edu	380G Cunz Hall	Differential Equation Models and R

COURSE GOALS

- Provide an introduction to applied infectious disease modeling suitable for health professionals and graduate students intending to pursue further study of the use of this research tool.

COURSE OUTCOMES

- Derivation and application of basic theories of infectious pathogen dynamics including thresholds for disease, herd immunity, and basic reproduction number.
- Identification and development of simulation models of diseases with different transmission pathways, parameterization of the models using data from field/lab or literature, and assessment of the model validity.
- Employment of models to assess health risks associated with infectious disease in humans/animals and evaluation of different disease control and prevention strategies.
- Employment of models to assess health impacts associated with changes in anthropogenic and environmental factors in the context of infectious diseases.
- Critique of modeling papers on infectious diseases/pathogens.

GRADING INFORMATION AND POLICIES

This section indicates how assignments, assessments, and other course activities contribute to final course grade.

Each of which will be categorized as one of the following "types":

- Type 1: An examination, quiz, or graded activity administered in class, and taken individually with no notes, resources, or collaboration. This is the most common form of midterm and final examination.
- Type 2: An examination, quiz, or graded activity administered in class and taken individually with open notes or resources. Some faculty allow students to use notes during midterms, finals, and quizzes.
- Type 3: An in-class, collaboratively taken examination, quiz, or graded activity that may involve open notes or resources.
- Type 4: An out-of-class, open-resource, and collaborative examination or quiz. Students may be working in assigned groups or groups of their choosing and assessments may be turned in as a group or individually.
- Type 5: A graded out-of-class written paper, longer case study analysis and/or illustrated project. The faculty member determines if the graded activity is done individually or in groups.

How Grades will be Determined

Grades for graduate and professional students will include three components – lab reports, case studies, and a final project. There are 8 reports based on lab work. Specific modeling exercises will be assigned together with lab tutorial materials and the student is expected to follow the tutorial and finish up the exercises and a report emphasizing the application of the concepts learned in lab. A case study modeling paper will be assigned each class to provide an application of the lecture and lab topics. Each student is required to participate in a discussion of the methods used by the researchers and an assessment of how well the modeling techniques are performed and applied to the topic of investigation. Also, students are required to develop a model, use it to answer a question about the disease or its control, and present the results of the investigation in a group (e.g. 2 persons/group). A final report (10-page limit not including figures, references, and appendices) based on the class project is required and due following the last class. To encourage steady progress in the project throughout the quarter, the final project will include due dates for ungraded parts of the final project. While **lab reports and case studies** may be discussed among students and discussion is encouraged, the final report or online discussion post must be the work of the **individual** submitting the work. The **final project** is a **group project** and represents the work of the entire group. Plagiarism will not be tolerated.

Undergraduate students are required to turn in lab reports and discuss case studies as described above. They are also required to evaluate the group project presentations on the final day of class. If undergraduate students wish, they may write a model of a disease of their choice, and turn in the code and a report of how the code is appropriate for the disease they chose including a figure of the model output. A grade of this report can be substituted for the student's lowest lab grade. All work for undergraduates is intended to be **individual**. The grade distribution for undergraduate students is lab reports (70%), case study discussions (25%), presentation evaluations (5%).

Exams

Please review the Exam Procedures document on CVM Community in the Group: Professional Programs Support within the "Student Resources". For courses using ExamSoft, please verify compatibility with your personal device at examsoft.com.

Grading Scale Used

A	=	93.0 - 100
A-	=	90.0 - 92.9
B+	=	87.0 - 89.9
B	=	83.0 - 86.9
B-	=	80.0 - 82.9

C+	=	77.0 - 79.9
C	=	73.0 - 76.9
C-	=	70.0 - 72.9
D+	=	67.0 - 69.9
D	=	60.0 - 66.9
E	=	Below 60

Grading Distribution Used

Lab reports	30%	Type 5
Case study discussions	20%	Type 5
Class project presentation	10%	Type 3
Class project report	40%	Type 5

Assignments

Due Dates

- September 8 - Case study 1; Lab 1
- September 15 - Case study 2; Lab 2; Project background
- September 22 - Case study 3; Lab 3
- September 29 - Case study 4; Lab 4
- October 6 - Case study 5; Lab 5
- October 20 - Case study 6; Lab 6; Project equations
- October 27 - Case study 7; Lab 7
- November 3 - Case study 8; Lab 8
- December 1 - Presentations; Final Papers

SCHEDULE

Date		Time	Location	Topic	Instructor(s)
August	25	2-5pm	Wenger Lab *	Course Introduction & Tutorial Using R	Garabed/ Pomeroy
September	1	2-5pm	Wenger Lab *	The Basic SIR Model	Pomeroy
September	8	2-5pm	Wenger Lab *	Thresholds and R0	Pomeroy
September	15	2-5pm	Wenger Lab *	Choosing Disease States in Models	Garabed
September	22	2-5pm	Wenger Lab *	Control of Infectious Diseases	Garabed
September	29	2-5pm	Wenger Lab *	Host Heterogeneity	Pomeroy
October	6	2-5pm	Wenger Lab *	Environmental Heterogeneity	Garabed
October	20	2-5pm	Wenger Lab *	Simulation vs. Data Fitting	Pomeroy
October	27	2-5pm	Wenger Lab *	Agent-Based Models 1	Calinger-Yoak
November	3	2-5pm	Wenger Lab *	Agent-Based Models 2	Calinger-Yoak/ Mielke
November	17	2-5pm	Wenger Lab *	Class Project Work	Garabed
December	1	2-5pm	Wenger Lab *	Class Project Presentations	Garabed/ Pomeroy

* Wenger Lab is on the second floor of the Veterinary Medicine Academic Building

COURSE POLICIES

Participation Policy

All students are expected to be present for each class. Please contact an instructor in advance if you cannot be present on a particular day.

ADDITIONAL INFORMATION FROM TEAM LEADER ABOUT ATTENDANCE

Attendance is not required, but all case study discussions and laboratories must be completed individually and on time whether or not you are present in the class and laboratory sessions. Please be considerate of other group members if you cannot meet with them to discuss your project during regular class times. Attendance is required for the final presentations (December 1st) unless you make other arrangements with the instructors (Skype, for example).

Academic Integrity and Misconduct

Graduate students are required to observe professional ethical standards in their graduate studies and research.

Graduate students should talk with their advisors and their graduate studies committee chair if they have questions about the specific expectations of the local graduate program. The Graduate Student Code of Research and Scholarly Conduct (Appendix B) describes the Graduate School's general expectations for ethics and conduct in graduate research and scholarship. University processes exist to address allegations of research misconduct by graduate students. Graduate students have the responsibility to be aware of and to follow these standards.

Research and Scholarly Misconduct. As a recipient of federal funding, the university is obligated to have an administrative process for reviewing, investigating, and reporting allegations of research misconduct. The *University Policy and Procedures Concerning Research Misconduct* is available on the Office of Research website.

When a Committee of Inquiry, as defined in the *University Policy and Procedures Concerning Research Misconduct*, forwards allegations of research misconduct by a graduate student to the Graduate School, the Graduate School follows the "Graduate School Policy on the Investigation of Allegations of Research Misconduct" (Appendix B).

Academic Misconduct. The university's Committee on Academic Misconduct is responsible for reviewing charges of academic misconduct against students, including graduate students. The Code of Student Conduct defines the expectations of students in the area of academic honesty.

Disability Statement

Any 1st-4th year veterinary student who believes s/he may need an accommodation based on the impact of a disability should contact the Office for Disability Services (ODS) at 614-292-3307, slds@osu.edu, or the CVM ADA Coordinator at 614-688-8756, el-khoury.7@osu.edu to coordinate reasonable accommodations. All students must have approval for their accommodations from ODS and meet with the CVM ADA Coordinator prior to accommodations being implemented. No accommodations will be provided retroactively.

Electronic Devices/Instructional Technology Policies

There are a limited number of computers available in Wenger Laboratory. It is recommended that you bring a laptop to class if you have one. Software used in the class may not work on iPads and Android tablets, so a laptop is preferred. Please contact the instructor if you have questions about your device.

COURSE RESOURCES/TEXTBOOKS

Background Reading:

- Bansal S, Grenfell BT, Meyers LA (2007) When individual behaviour matters: homogeneous and network models in epidemiology. J R Soc Interface 4: 879-891.
- Daley, D.J. & Gani, J. (2005) Epidemic Modeling: an Introduction. Cambridge University Press. New York, NY. ISBN 978-0-521-01467-0.
- Fisman DN (2007) Seasonality of infectious diseases. Annu Rev Public Health 28: 127-143.
- Keeling, M.J. & Rohani, P. (2008) Modeling Infectious Diseases in Humans and Animals. Princeton University Press. Princeton, NJ. ISBN 978-0-691-11617-4. **(Vet Med Library Reserves)**
- Kopec, J.A., et al. (2010) Validation of population-based disease simulation models: a review of concepts and methods. BMC Public Health 10: 710. http://www.biomedcentral.com/1471-2458/10/710.
- Lloyd-Smith, J.O., et al. (2005) Should we expect population thresholds for wildlife disease? TRENDS in Ecology and Evolution 20(9): 511-519. doi: 10.1016/j.tree.2005.07.004
- McCallum, H., et al. (2001) How should pathogen transmission be modeled? TRENDS in Ecology and Evolution 16(6): 295-300. doi: 10.1016/S0169-5347(01)02144-9
- Vynnycky, E. & White, R.G. (2010) An Introduction to Infectious Disease Modelling. Oxford University Press. New York, NY. ISBN 978-0-19-856-576-5 **(Vet Med Library Reserves)**

Case Study Papers: *Available on CARMEN*

Justification

Explain why this course provides a unique learning experience that will enhance a student's education:

The course is designed as an introduction to modeling risks associated with transmission processes and control of infectious diseases. The course covers basic concepts and theories on infectious disease epidemiology and transmission dynamics, and basic tools to both critically read modeling papers and to develop and use models as research tools. Emphasis will be placed on using quantitative techniques (e.g. both statistical and mathematical) to understand infectious disease processes, how environmental factors mediate the transmission of these pathogens thereby posing public health risks; and to use models to screen public health interventions and optimize surveillance strategies. This course is intended for, but not limited to, graduate students and professionals in public health, medicine, veterinary medicine, and ecology & evolution biology. The class meeting consists of both lecture material covering conceptual issues and a computer lab to apply these concepts using standard infectious disease models.

The emphasis of this course is unique compared with similar courses offered at Ohio State University in the departments of Mathematics, Public Health Epidemiology, and Ecology, Evolution, and Organismal Biology (EEOB). While other courses emphasize ecological theories or mathematical calculations, our course emphasizes applications of modeling for infectious diseases. In this way, we provide an easy introduction to the topic that allows students to experiment with the capabilities of modeling and evaluate the use of published models without too much time spent in proofs and theories. In this way, our course is ideal for a professional looking at expanding his/ her knowledge or for a student trying to decide if he/ she wishes to spend more time learning about disease modeling. Taking this course as an introduction to the Mathematics or EEOB courses will allow health sciences students to have a context in which to place what they learn in their future course work.

If known, cite other courses, within or external to the college, which this course will complement or

supplement:

- Math 1157: Mathematical Modeling for the Biological Sciences
- Math 3350: Introduction to Mathematical Biology
- Math 5651: Mathematical Modeling of Biological Processes
- EEOB 3410: Ecology
- EEOB 5450: Population Ecology
- EEOB 7220: Modeling in Evolutionary Ecology

- PUBHEPI 5421 - Mathematics of Infectious Disease Dynamics

- PUBHBIO 8450 - Stochastic Epidemic Models

Please specify the term or terms (spring semester, autumn semester, May term, summer session) that you propose to offer the course and explain why this is the most appropriate time(s) to offer the course:

Autumn Semester provides are fewer conflicts for professional and dual-degree students, so more students will be able to take the class.

If you propose to grade this course as SUS (satisfactory/unsatisfactory), explain why this is necessary or desirable:

Please list the prerequisites for this course, if any: