



POPM*6800 Infectious Disease Modeling

Winter 2020

Section(s): C01

Department of Population Medicine

Credit Weight: 0.50

Version 1.00 - January 07, 2020

1 Course Details

1.1 Calendar Description

This course covers concepts, principles and methods of basic and applied epidemiology, including the following topics: sampling, measuring disease frequency, clinical epidemiology, descriptive epidemiology, causal reasoning and design, interpretation and critical appraisal of surveys, observational studies, field trials and critical appraisal.

Pre-Requisites: POPM*6200 and successful completion of an undergraduate course in differential calculus.

Restrictions: Instructor consent required.

1.2 Course Description

This course will serve as a basic introduction to mathematical modeling of infectious diseases using examples from public and veterinary health. Students completing this course will have the ability to critically appraise published mathematical models, and to build, parameterize, and analyze simple compartmental models.

How can we prevent and control infectious disease outbreaks? This is why you are here – to answer this question. If you understand what drives the transmission dynamics of infectious pathogens in populations, then you can better act to prevent and control the spread of pathogens. This course covers ten broad content and methods areas related to mathematical epidemiology of infectious diseases, which combine a substantive focus (i.e., relevant clinical, pathological, and ecological information about a given pathogen or group of pathogens) with methodological tools useful for their representation via modeling. Each session is 3 hours in length. Most weeks will include an initial 30-60 min. introductory lecture,

followed by hands-on exercises. With other weeks entirely focused on hands-on exercises and discussion. I believe that this material is difficult to understand without practice so you will need to bring a laptop to class to participate in the laboratory exercises.

1.3 Timetable

In class: 3 hours per week

1.4 Final Exam

This class does not have a final exam.

2 Instructional Support

3 Learning Resources

3.1 Required Resources

Microsoft Teams (Software)

Course material, news, announcements, discussion items, assessments, and feedback will be regularly posted to the POPM*6800 Microsoft Teams group. You are responsible for checking the group regularly. Students will be added to the group by the course instructor. The Teams group (and the associate OneNote notebooks) will also be the tool used for peer and self-assessment and all collaborative work assignments completed in class.

Computer Resources (Equipment)

You will be expected to bring a laptop to class, in order to perform the modeling exercises that are the core of this course. R Studio will be required in order to complete the exercises.

Much of the course material that we will cover in this course will be completed using R. This means that developing an understanding of **HOW** to program mathematical models in R requires that you spend a bit of time thinking about R programming in general.

3.2 Recommended Resources

Datacamp programming resources (Website)

All students enrolled in the class will be provided access to the full library of online training at DataCamp (<https://www.datacamp.com>). These resources are meant to help to supplement the needs of individual students based on their previous experience using R for data manipulation, management, analysis, and visualization. Enrolled students will be added to the data camp group by the instructor.

3.3 Additional Resources

Suggested Resources (Textbook)

There is **no required text** for this course, and all required and recommended readings will be provided on Course Link. However, the course is built upon approaches to disease modeling described in two texts, both of which are available in the library, and which can be readily purchased from a variety of sources.

1. Vynnycky E and White RG. *An Introduction to Infectious Disease Modelling*. Oxford University Press, New York, NY 2010.
2. Keeling MJ and Rohani P. *Modeling Infectious Diseases in Humans and Animals*. Princeton University Press, Princeton NJ. 2008.

4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Demonstrate a basic understanding of the subject area (e.g., factual knowledge, methods, principles, generalizations, theories)
2. Apply course material (to improve thinking, problem solving, and decisions) to both veterinary and human health problems.
3. Analyze and critically evaluate scientific ideas, arguments, and points of view
4. Demonstrate appropriate methods for collecting, analyzing, and interpreting numerical information
5. Demonstrate the specific skills, competencies, and points of view needed by professionals in human and veterinary health

5 Teaching and Learning Activities

5.1 Lecture

Week 1

Topics: What will I learn from this course, how will I learn it, and how will I be assessed?

Laying the foundation – Infectious Disease Epidemiology
What are the fundamental properties of communicable diseases that contribute to disease transmission?

Week 2

Topics: **Introduction to dynamic systems**

How do you translate host-pathogen biology into a system of mathematical equations?

Week 3

Topics: **Planning session for:**

1) Group projects

2) Portfolios

2) Learning conferences

Week 4

Topics: **Contact patterns and mixing**

What about populations with more specific mixing patterns?
Why is it important to consider the population contact patterns?

Week 5

Topics: **Disease prevention and control**

How can we implement health interventions such as vaccination programs into models?

Week 6

Topics: Model fitting and parameter estimation

What can we learn from the basic reproductive number of a pathogen and why is it important?

Week 7

Topics: WINTER BREAK (no class)

Week 8

Topics: Parameter uncertainty and sensitivity analysis

How do we analyze models to better understand the uncertainty that exists and the relationship between model inputs and model outputs?

Week 9

Topics: Stochastic models

What is a stochastic model? How is it different from a deterministic model? How do we implement stochasticity into our model equations?

Week 10

Topics: Vector-borne diseases

What do insects, healthcare workers, and spinach have in common? How do you incorporate disease transmission routes that include vectors into your compartment models?

Week 11

Topics: Group project work period

Week 12

Topics: Presentation of final projects

Week 13**Topics: Individual portfolio reviews and final learning conferences**

6 Assessments

6.1 Assessment Details

Exit ticket 1 (4%)**Due:** Wed, Jan 8**Learning Outcome:** 1, 5**Assignment 1 (6%)****Due:** Wed, Jan 15**Learning Outcome:** 1, 2, 3, 4, 5**Assignment 2 (6%)****Due:** Wed, Jan 22**Learning Outcome:** 1, 2, 3, 4, 5**Exit ticket 2 (4%)****Due:** Wed, Jan 29**Learning Outcome:** 1, 2, 3, 4, 5**Project task 1- Project Plan (6%)****Due:** Fri, Jan 31**Learning Outcome:** 1, 2, 3, 4, 5**Midterm learning conference - evidence journal (6%)****Due:** Fri, Feb 7**Learning Outcome:** 1, 2, 3, 4, 5**Midterm learning conference - Self assessment (6%)****Due:** Fri, Feb 7**Learning Outcome:** 1, 2, 3, 4, 5**Exit ticket 3 (4%)****Due:** Wed, Feb 12**Learning Outcome:** 1, 2, 3, 4, 5**Midterm learning conference (6%)****Due:** Wed, Feb 12**Learning Outcome:** 1, 2, 3, 4, 5**Project Task 2A - Telling the Story (6%)****Due:** Tue, Feb 25**Learning Outcome:** 1, 2, 3, 4, 5**Project Task 2B - Peer assessment and feedback (6%)****Due:** Wed, Mar 4

Learning Outcome: 3, 4, 5

Project Task 3A - 1-page summary (6%)

Date: Wed, Mar 11

Learning Outcome: 1, 2, 3, 4, 5

Project Task 3B - Distribute updated summary to class (6%)

Due: Fri, Mar 20

Learning Outcome: 1, 2, 3, 4, 5

Project Task 4 - Project Pitch (6%)

Due: Wed, Mar 25

Learning Outcome: 1, 2, 3, 4, 5

Exit ticket 4 (4%)

Due: Wed, Mar 25

Learning Outcome: 1, 2, 5

Final learning conference - evidence journal (6%)

Due: Fri, Mar 27

Learning Outcome: 1, 2, 3, 4, 5

Final learning conference - Self assessment (6%)

Due: Fri, Mar 27

Learning Outcome: 1, 2, 3, 4, 5

Final learning conference (6%)

Due: Wed, Apr 1

Learning Outcome: 1, 2, 3, 4, 5

7 University Statements

7.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

7.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

7.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes
<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses
<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

7.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

7.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website
<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website
<https://www.ridgetownc.com/services/accessibilityservices.cfm>

7.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

7.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

7.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars

<https://www.uoguelph.ca/academics/calendars>
