Mathematics 747 / 5GT3

Topics in Mathematical Biology: Pandemic Modelling

Course Information Sheet, Fall 2020

Instructor: David Earn
Office: Hamilton Hall 317
Office Hours: By Appointment (online only)
E-mail: earn@math.mcmaster.ca
Home page: http://davidearn.mcmaster.ca

Class Location: Virtual Classroom
If you are not registered in the course, but would like to attend, e-mail earn@math.mcmaster.ca.

Class Times:

- Wednesdays 9:30am – 12:20pm
- *Alternative times may be considered, subject to feasibility for all participants.*
- Classes will normally take place synchronously, possibly with some asynchronous components.

Prerequisites: MATH 3F03 "Advanced Differential Equations" or an equivalent course in the qualitative theory of nonlinear ordinary differential equations, or permission of the instructor. Familiarity with an open-source programming language (R, Python, or MATLAB/Octave) will be useful, since you will need to use R in the course.

Course Content: Introduction to mathematical modelling of infectious disease (ID) transmission. Application of ID models to understanding historical pandemics and the ongoing pandemic of SARS-CoV-2. Critical evaluation of infectious disease modelling research papers, especially in connection with the current pandemic.

Course Objectives:

- Learn the basics of mechanistic epidemic modelling.
- Become familiar with some primary research literature in mathematical epidemiology.
- Monitor and discuss public COVID-19 data, and modelling of the ongoing pandemic.

- Learn to use R packages that our group at McMaster has developed, and is using for COVID-19 research and advice to policymakers.
- Write a paper that reviews and/or contributes to COVID-19 modelling research.

Course web site: https://davidearn.github.io/tmb2020/
Course information, including announcements, handouts, lecture slides, assignments, links to downloadable course-related software, *etc.*, will be available on the course web site. You are expected to check it regularly.

Participation: An important aspect of the course will be engaging in class discussion, presenting prepared material to the class, and giving feedback on the presentations of others. Attendance (virtually) at all classes is mandatory.

Weekly update presentations: Each week one or two students will be expected to present a brief summary of new COVID-19-related research that uses mathematical models and/or is important for modellers to be aware of. Details will be discussed in class, but a starting point for identifying relevant research will be daily covid research scan summaries produced by the Public Health Agency of Canada (PHAC).

Assignments: There will be at least two assignments, which will involve using R packages for pandemic analysis and forecasting. Assignments must be typeset in LaTeX and all graphics must be prepared using `R`. Both a final pdf and all `knitr` source code must be submitted to a `github` repo (to be discussed in class). If you do not have a `github` account already, please create one.

Presentations: During the term, each student will present at least one journal article or preprint to the class. In addition, at the end of the course, each student will give an oral presentation about their final project. Slides for presentations must be prepared with the `beamer` package in LaTeX. Other expectations will be discussed in class.

Final Project: The most important component of the course is the final project. In addition to the project document, you will submit a "research notebook" or "lab book" in which you have kept track of all work done on the project over the course of the term. The notebook will be due together with the project. Details about the project will be discussed in class and a set of expectations will be posted on the course web site several weeks into the term.

Software: In order to complete the assignments and final project, you will be required to develop basic competence with software for mathematical typesetting (LaTeX), graphics and numerical analysis (`R`). These applications are all open-source free software projects and can be downloaded and installed on any computer.

- LaTeX: http://www.latex-project.org/

- R: http://www.r-project.org

You will need to install these applications on your computer.

Course style: Early in the course, most of the presentations will be from the instructor. There will be a mixture of lectures about epidemiological modelling theory and demonstrations/tutorials associated with software packages. Later in the course, students will be presenting more and there may be some guest lectures.

Communicating with the instructor: You will need to communicate with me by e-mail. Please bear in mind that I am overwhelmed by e-mail (during the COVID-19 pandemic it has become common for me to receive 200+ e-mails in a day.). It is easy for me to miss important messages. Please include a helpful, descriptive subject line in any e-mail that you send to me. The subject line should always have the form "`Math 747: ...`". Examples might be:

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Math 747: confusion about assignment 1, problem 2a
Math 747: progress on extra challenge problem
Math 747: idea for final project
Math 747: dog ate my laptop
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Communicating with you: If you do not check your McMaster e-mail every day, then please provide me with an alternative method of communication (*e.g.,* an e-mail address that you do check daily, or your cell number). Make sure to check your e-mail before class in case of any changes. If something goes wrong with the video link for class, check your e-mail for information.

Final Grade: Your final grade will be determined as follows (tentatively; I am open to other possibilities if we can agree on a different marking scheme that is acceptable to everyone).

Component	Weight
Weekly Update Presentations	10%
Article Presentation(s)	10%
Assignments	20%
Final Project	40%
Oral Presentation of Final Project	10%
Attendance and Participation	10%

You are expected to attend every class. Participation includes completing online surveys and peer evaluations in a timely manner.

Reference list

There is no course textbook. However, the following articles should be helpful:

- **Earn, D.J.D.**, 2004. "Mathematical modelling of recurrent epidemics." *Pi in the Sky*, **8**, 14–17 (Intended audience: Keen high school mathematics students)
- **Earn, D.J.D.**, 2008. "A light introduction to modelling recurrent epidemics." In *Mathematical Epidemiology*, F. Brauer, P. van den Driessche, J. Wu (editors) *Lecture Notes in Mathematics* **1945**, Springer, pp. 3–18 (Intended audience: undergraduate mathematics students)
- **Earn, D.J.D.**, 2009. "Mathematical epidemiology of infectious diseases." In *Mathematical Biology*, M.A. Lewis, M.A.J. Chaplain, J.P. Keener, P.K. Maini (editors) *IAS/Park City Mathematics Series* Volume **14**, American Mathematical Society, pp. 151–186 (Intended audience: senior undergraduate and beginning graduate mathematics students)

These articles and some of the other papers that will be discussed during the course are available at https://davidearn.mcmaster.ca/publications.

The following books may also be useful references:

- "Infectious Diseases of Humans: Dynamics and Control" by Roy Anderson and Robert May (Oxford, 1991).
- "Mathematical models in population biology and epidemiology" by Fred Brauer and Carlos Castillo-Chavez (Springer, 2001).
- "Modeling Infectious Diseases in Humans and Animals" by Matt Keeling and Pej Rohani (Princeton, 2008).
- "Nonlinear Dynamics and Chaos" by Steven H. Strogatz (1994).
- "Simulating, Analyzing, and Animating Dynamical Systems: A Guide to XPPAUT for Researchers and Students" by Bard Ermentrout (2002).

In addition, the following e-books available through the McMaster library system might be useful:

- "A Primer of Ecology with R" by M. Henry H. Stevens (Springer, 2009)
- "Data Manipulation with R" by Phil Spector (Springer, 2008)
- "Modern Infectious Disease Epidemiology Concepts, Methods, Mathematical Models, and Public Health" edited by Alexander Krämer, Mirjam Kretzschmar and Klaus Krickeberg (Springer, 2010)

Notes

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

Late Withdrawal Option

McMaster University provides a Late Withdrawal Option for students who have become irretrievably behind in a course. Those who have fallen behind with assignments and/or are not prepared to write the final examination (or submit an equivalent assessment) are encouraged to make use of this Option, and must contact their Academic Advisor in the Faculty/Program Office. Students may request a Late Withdrawal, without petition, no later than the last day of classes in the relevant term. The policy also specifies certain conditions that make a student ineligible for this Option.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's Academic Accommodation of Students with Disabilities policy.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, github, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software

during tests or exams. This software may be required to be installed before the test/exam begins.

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. *It is your responsibility to understand what constitutes academic dishonesty.* Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at `https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/`.

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to `www.mcmaster.ca/academicintegrity`.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all our living, learning and working communities. These expectations are described in the Code of Student Rights & Responsibilities (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, whether in person or online.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, including lectures by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

Disclaimer

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances (e.g., Covid-19 lockdown, severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

David Earn
5 September 2020