

Course information

Course code	GGR1218H5S Open Source Methods in Physical Geography	
Instructor	Dr. Trevor Porter, Assistant Professor Department of Geography University of Toronto Mississauga	e-mail: trevor.porter@utoronto.ca office location: DV 3280 office hours: by appointment phone: 905-828-5314
E-mail policy	Always use your University of Toronto email address (@mail.utoronto.ca) for course related communications. Other email addresses may be filtered as spam.	
Description	<p>In the era of ‘Big Data’, quantitative datasets used in physical geography and the earth sciences have grown rapidly in size and complexity which demand custom programs to efficiently manage, analyse and visualise spatiotemporal phenomena. Self-describing, multi-dimension file formats (e.g., NetCDF), which are common in the spatial sciences and, notably, cannot be opened with traditional spreadsheet software (e.g., MS Excel), epitomize the challenges geographers face in this neo-quantitative revolution. Routine and more customized analyses of large, complex datasets are ideally handled in a programming environment that is widely used by the research community, which benefits from knowledge exchange in community-run online forums and open-source code sharing.</p> <p>This course is organised as a series of workshops with practical training in R (basic training only) and MATLAB, which are two of the most widely used programming languages in the geosciences. The workshops will focus mainly on applications of data mining, exploration and management; working with NetCDF files; publication-quality figures and data visualisation; statistical analysis; linear regression modelling; time-series analysis and signal processing; and mapping. Students will complete three assignments to hone their coding and problem-solving skills, and a final project that applies these skills to their research. This course is aimed at students with little to no coding experience.</p>	
Learning objectives	<p>The primary course objective is to develop core competencies and confidence in R and MATLAB, and more generally a basis for solving quantitative problems in an open-source environment. Specific course objectives are to:</p> <ul style="list-style-type: none">• Manage, mine, explore and visualise large datasets• Design and edit custom, open-source programs• Implement signal processing, spatial analysis and mapping functions• Apply statistical tests to spatial and temporal datasets• Produce high-quality figures that meet publication standards• Develop custom code to address practical research problems	

Required textbook	There is no required text. Readings and notes will be posted online as necessary.
Required software	<p>All required software (MATLAB, R and R Studio) will be available on the lab computers. Alternatively, students may wish to install the required software on their personal laptop computers.</p> <p>A MATLAB student licence can be downloaded via the University of Toronto bookstore. Download R (v3.6.2 or newer) from https://cran.rstudio.com/ and RStudio Desktop (v1.2.5 or newer) from https://www.rstudio.com/products/rstudio/download.</p>
Online resources	<p>A MATLAB basics tutorial is available on the Mathworks website, here: https://www.mathworks.com/help/matlab/getting-started-with-matlab.html.</p> <p>R in a Nutshell: http://guianaplants.stir.ac.uk/seminar/resources/R_in_a_Nutshell_Second_Edition.pdf</p> <p>R for Data Science: https://r4ds.had.co.nz/index.html</p>
Times & places	Mondays, 2-5 PM (refer to schedule below). Online synchronous via Bb Collaborate (on Quercus). Please ensure you have a reliable internet connection if you are working from home. If you are using your personal computer, please ensure that you have the ability to install the required software (see above).

Course schedule

The lesson plan outlined below is subject to change at the instructor's discretion.

Sept. 14	[<i>fundamentals</i>] R and R Studio. Programming environment, import/export and basic data operations.
Sept. 21	[<i>fundamentals</i>] R and R Studio. Statistical analysis.
Sept. 28	[<i>fundamentals</i>] MATLAB. Programming environment, import/export, basic data operations and working with matrices.
Oct. 5	[<i>fundamentals</i>] MATLAB. Data visualisation, plotting options and developing publication-quality figures.
Oct. 12	THANKSGIVING/READING WEEK – UNIVERSITY IS CLOSED
Oct. 19	[<i>fundamentals</i>] MATLAB. Data mining, logical indexing and conditional 'if' and 'for' loops.
Oct. 26	[<i>applications</i>] MATLAB. Time-series analysis and signal processing. Interpolation, break-point analysis, de-trending and filtering. Spectral and wavelet analysis.
Nov. 2	[<i>applications</i>] MATLAB. Mapping, spatial projections, visualising spatiotemporal evolution and working with self-describing, multi-dimensional NetCDF files.

Nov. 9	[<i>applications</i>] MATLAB. Statistical testing across space and time. Regression modelling. Calibration, validation and error analysis.
Nov. 16	[<i>project development</i>] One-on-one consult with the instructor to discuss the design of your final research project. Consult by appointment. <i>There is no workshop this week.</i>
Nov. 23	[<i>project development</i>] Project development, progress assessment and one-on-one instruction. <i>This is a regular workshop. Attendance/participation is mandatory.</i>
Nov. 30	[<i>project development</i>] Project development, progress assessment and one-on-one instruction. <i>This is a regular workshop. Attendance/participation is mandatory.</i>
Dec. 7	Final presentations – Students will deliver a presentation on their final research project. <i>This is a regular workshop. Attendance/participation is mandatory.</i>

Schedule of work

Assignment 1	Due before noon (12:00) on Oct. 26, 2020
Assignment 2	Due before noon (12:00) on Nov. 2, 2020
Assignment 3	Due before noon (12:00) on Nov. 16, 2020
Final report	Due anytime on Dec. 7, 2020

Assessment details

Participation (15%)

Participation includes both attendance and participation in all workshops; partial attendance will receive only half credit. Participation may include the completion of any assigned readings (usually assigned the week prior to the workshop), active learning, and completion of assigned activities (separate from assignments) with a defined objective and due date. Students who are unable to attend a workshop due to personal or medical reasons must provide supporting documents (e.g., doctor's note) to the instructor in order to excuse the absence.

Assignments (60%)

There are 3 assignments, each worth 20% of the final grade. Due dates are indicated above (see schedule of assigned work). Complete assignments are eligible for full marks, and partially completed assignments are eligible for half marks. To receive full marks, students must fully address each question and demonstrate their competency in the subject matter.

All assignments must be completed independently (i.e., non-collaboratively). Students are permitted to consult with each other on specific programming challenges. However, working through assignment instructions in teams is strictly prohibited. Assignment instructions will be provided via the course web portal one week before the assignment is due.

Research project (25%)

In consultation with the instructor, students will undertake a MATLAB-based analysis that contributes in a substantial way to their thesis. Deliverables from this project include an oral presentation [15% of the final grade] and a written report [10% of the final grade].

[*Presentation*] This research will be presented to the class as a short-format oral presentation on the last day of class. Requirements for the presentation will be communicated in the second half of the semester.

[*Final report*] This research must be documented in full detail in a report that is structured similarly to a formal manuscript including the following sections: introduction, methods, results and discussion, conclusions, references, and an appendix with all datasets and lines of code needed to replicate the analysis. Other requirements will be communicated in the second half of the semester.

Policy statements

Late Term Work

Late assignments will be subject to a late penalty of 10% per day (including weekends) of the total marks for the assignment. Assignments submitted five calendar days beyond the due date will be assigned a grade of zero.

Accessibility Needs

The University of Toronto is committed to accessibility. If you require accommodations for a disability, or have any accessibility concerns about the course, the classroom or course materials, please contact Accessibility Services as soon as possible: <http://studentlife.utoronto.ca/as>

Equity statement and academic rights

The University of Toronto is committed to equity and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect. As a course instructor, I will neither condone nor tolerate behaviour that undermines the dignity or self-esteem of any individual in this course and wish to be alerted to any attempt to create an intimidating or hostile environment. It is our collective responsibility to create a space that is inclusive and welcomes discussion. Discrimination, harassment and hate speech will not be tolerated. If you have any questions, comments, or concerns you may contact the UTM Equity and Diversity officer at edo.utm@utoronto.ca or the University of Toronto Mississauga Students' Union Vice President Equity at ypequity@utmsu.ca.

**Academic Integrity/
Honesty or Academic
Offenses:**

It is your responsibility as a student at the University of Toronto to familiarize yourself with, and adhere to, both the Code of Student Conduct and the Code of Behaviour on Academic Matters. This means, first and foremost, that you should **read** them carefully.

The Code of Student Conduct is available [here](#), or in your print version of the Academic Calendar. The Code of Behaviour on Academic Matters is available [here](#), or in your copy of the Academic Calendar. Another helpful document to review is How Not to Plagiarize by M. Proctor, available [here](#).