UNIVERSITY of GUELPH

ENVS*3340 Environmental Data Analysis

Fall 2022
Section(s): 01

School of Environmental Sciences
Credit Weight: 0.50
Version 1.00 - September 07, 2022

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1 Course Details

1.1 Calendar Description

This course is focused on interpreting data of the physical environment. Students will access various online databases, such as meteorological and hydrological time series, and perform and interpret statistical analysis with the data. Issues around errors and data collection will be explored by performing simple experiments. Students will make a numerical simulation of a dynamic environmental phenomenon. Students will produce and interpret graphical presentations of data.

Pre-Requisites: 1 of ECON*2740, GEOG*2460, STAT*2040, STAT*2060, STAT*2230

1.2 Course Description

This course is focused on finding, collecting and interpreting data of the physical environment. Students will access various online databases, such as meteorological and hydrological time series, and perform and interpret statistical analysis with the data. Issues around calibration and data collection may be explored by performing calibrations and experiments. Students will also make a numerical simulation of a dynamic environmental phenomenon.

1.3 Timetable

Lecture: Wed, 3:30 pm-5:20 pm; ROZH, Room 109
Lab: Fri, 02:30 pm-5:20 pm; ANNU, Room 306

Please note that 100% of class activities are planned to occur in person: students are expected to attend class and lab sessions weekly to participate in lectures and make the most of lab tutorials. Attending lab sessions is highly recommended as it is only during those sessions that the instructor and teaching assistant will provide guidance for coding in R and Python and be available to help troubleshoot coding issues. One-on-one help for coding in R and Python or understanding assignment questions will not be provided by email. In the

advent that during the Fall 2022 term, the epidemiological situation may worsen, and we may pivot to online learning, synchronous class activities will be organized: this means that the instructors will give "live" lectures and modelling tips and students will expected to take part in "live" lab sessions. Video recordings of class activities (lectures and labs) will be not be routinely made available on CourseLink.

1.4 Final Exam

There is no final exam for this course.
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2 Instructional Support

2.1 Instructional Support Team

Instructor:	Laura Brown Dr.
Email:	laura@uoguelph.ca
Office Hours:	By appointment

2.2 Teaching Assistants

Teaching Assistant (GTA):	Charlotte Coates (semester weeks 1-13, i.e., Sept. 10 through Dec. 1)
Email:	coatesc@uoguelph.ca
Office Hours:	By appointment

2.3 Communicating with the Instructional Team

Announcements: Announcements on the course website homepage (on CourseLink) will be used to provide course reminders and updates. Please check this section frequently for course updates.

Class time: You can interact with the instructor and the teaching assistant weekly i.e., 2 hours of lecture and 3 hours for the lab. The best time to work with us is during these scheduled times, especially for asking questions about coding in R or Python or for asking questions related to the lab assignments.

Email: If you have a conflict that prevents you from completing course requirements or have a question concerning a personal matter, you can send the instructor a private message by email. The instructor will attempt to respond to your email within 48 hours (weekends and holidays excepted).

Video Call: This option for communication will only be available if we pivot to online learning and no in-person class activities are taking place. In the advent of online-only teaching, if you have a complex question you would like to discuss with the instructor, you may book a video meeting on Microsoft Teams. Video meetings will depend on the instructor's availability and will be booked on a first-come, first-served basis.

Please note that neither emails nor video calls should be used in lieu of attending lectures and labs.

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3 Learning Resources

3.1 Required Resources

Textbook and Electronic Device(s) (Equipment)
No textbook is required. Access to a personal computer (laptop) is required for the course.

Course Technologies and Technical Support (Software)
CourseLink: The course website is available via CourseLink. CourseLink (powered by D2L's Brightspace) is the University of Guelph's online learning management system (LMS). By using this service, you agree to comply with the University of Guelph's Access and Privacy Guidelines. Please visit the D2L website to review the Brightspace privacy statement and Brightspace Learning Environment web accessibility standards.

http://www.uoguelph.ca/web/privacy/

https://www.d2l.com/legal/privacy/

https://www.d2l.com/accessibility/standards/

You are responsible for ensuring that your computer system meets the necessary CourseLink system requirements. Use the browser check tool to ensure your browser settings are compatible and up to date (see links below).

http://spaces.uoguelph.ca/ed/system-requirements/

https://courselink.uoguelph.ca/d2l/systemCheck

If you need any assistance with the software tools or the CourseLink website, contact CourseLink Support.

Email: courselink@uoguelph.ca

Phone: 519-824-4120 ext. 56939 Toll-Free (CAN/USA): 1-866-275-1478

Support Hours (Eastern Time):

Monday-Friday: 8:30 am–8:30 pm

Saturday: 10:00 am–4:00 pm

Sunday: 12:00 pm–6:00 pm

Zoom: In the advent that in-person class activities are cancelled, and we pivot to online

learning, this course will use Zoom for synchronous lectures and labs. Check your system requirements to ensure you will be able to participate.

https://opened.uoguelph.ca/student-resources/system-and-software-requirements

Direct links to the Zoom virtual classroom will be posted on CourseLink (under Content -> Modules -> Zoom).

Teams (via Office 365): In the advent that in-person class activities are cancelled, and we pivot to online learning, this course will use Teams for occasional one-on-one meetings with the instructor (see section 2.3 of the course outline). Office 365 Teams is a collaboration service that provides shared conversation spaces to help teams coordinate and communicate information. It is recommended that you use the desktop version of Teams. As a student, you are responsible for learning how to use Teams and its features.

For Teams support, visit the CCS website for more information.

https://www.uoguelph.ca/ccs/services/office365/teams

R: R is a free software environment for data visualization and statistical computing, and it will form the basis of many lab assignments. Additional details about how to work within the R environment will be provided during weekly lab sessions. R can work on different operating systems (Windows, Mac, Unix) and is also available in different versions (R versus RStudio). While it is possible for you to succeed in this course regardless of the operating system and software version that you decide to use, please note that the instructors' expertise mainly lies with RStudio on Windows. The instructor and TA may therefore not be able to troubleshoot issues specific to other operating systems.

For R support, visit the Comprehensive R Archive Network website.

https://cran.r-project.org/

For Rstudio support, visit

https://www.rstudio.com/products/rstudio/

Python: Python is a free programming language that will also be used for some labs. Further information about downloading and using Python will be provided in class.

For Python support, visit the following website:

https://www.python.org

Technical Skills (Other)
As part of your learning experience, you are expected to use a variety of technologies for assignments, lectures, teamwork, and meetings. In order to be successful in this course, you will need to have the following technical skills:

--> Manage files and folders on your computer (e.g., save, name, copy, backup, rename, delete, and check properties);

--> Install software, security, and virus protection;

--> Use office applications (e.g., Word, PowerPoint, Excel, or similar) to create documents and convert them into a PDF;

--> Be comfortable uploading and downloading saved files;

--> Communicate using email (e.g., create, receive, reply, print, send, download, and open attachments);

--> Navigate the CourseLink learning environment and use the essential tools, such as Dropbox, Quizzes, Discussions, and Grades;

--> Access, navigate, and search the Internet using a web browser (e.g., Firefox, Edge); and

--> Perform online research using various search engines (e.g., Google) and library databases.

Use online support resources if you need assistance with any of the above.

Netiquette Expectations (Other)
The course website is considered the classroom. The same protections, expectations, guidelines, and regulations used in face-to-face settings apply to the course website and to the virtual classroom (in the advent that we pivot to online learning and lectures are delivered through Zoom). Inappropriate behaviour will not be tolerated. Examples of inappropriate online behaviour include:

--> Posting inflammatory messages about the instructor or fellow students;

--> Using offensive language;

--> Copying or presenting someone else's work as your own;

--> Adapting information from the Internet without using proper citations or references;

--> Buying or selling term papers or assignments;

--> Posting or selling course materials to course notes websites;

--> Having someone else complete your quiz or completing a quiz for/with another student;

--> Stating false claims about lost quiz answers or other assignment submissions;

--> Threatening or harassing a student or instructor;

--> Discriminating against fellow students, instructors, and/or TAs;

--> Using the course website to promote profit-driven products or services;

--> Attempting to compromise the security or functionality of the learning management system; and

--> Sharing your username and password.

3.2 Additional Resources

Lecture Notes and Library Access (Readings)
I will post the slides I use in my lectures on CourseLink so you can follow along and take notes. Students will be expected to annotate these in class. The instructor post links to videos, tutorials, and websites to supplement class material. Google can also be a useful resource for this course.

As a student, you have access to the University of Guelph's library collection, including both physical and electronic materials. For information on checking out library items, accessing electronic journals and returning items to the library, visit the library website.

If you are studying off-campus and would like to access the library's electronic resources, use the Off-Campus Login option and log in, either by using your Single Sign-On credentials or by using your last name and library barcode.

https://www.lib.uoguelph.ca/

https://www.lib.uoguelph.ca/campus-login

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4 Learning Outcomes

4.1 Specific Learning Outcomes

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

1) Source and access data sets using multiple techniques

2) Create and edit visualizations of environmental data with R

3) Import, review, manipulate and summarize environmental datasets in R

4) Implement statistical analyses and tests in R

5) Select appropriate statistical analyses in light of specific objectives

6) Quantify errors and uncertainties in data and models

7) Create a simulation of a dynamic environmental phenomenon

8) Program and execute basic simulation models in Python

9) Identify and access public environmental databases and use the data in analyses

10) Communicate analysis results in writing, orally and graphically according to scientific standards

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5 Teaching and Learning Activities

5.1 Lectures

The schedule below is tentative; it may be adjusted through the term as needed.

Sept. 14: Descriptive and inferential statistics, Environmental data quality

Sept. 21: Data visualization

Sept. 28: Comparing data distributions

Oct. 5: Correlation and regression

Oct. 12: Hypothesis testing

Oct. 19: Case studies: misleading graphs and how to lie (or not) with statistics

Oct. 26: Midterm

Nov. 2: Writing scientific articles & reports; Intro to Lab 5

Nov. 9: Numerical modelling & simulation   Heat flow modelling

Nov. 17: Weather forecasting and climate models; Climate change

Nov. 24: Writing strategies; Example time series analyses

Dec. 1: Options for post-undergrad

5.2 Labs

The schedule below is tentative; it may be adjusted through the term as needed.

Sept. 9: Syllabus review; What is data; Introduction to R and Rstudio

Sept. 16: Introduction to R and Rstudio (cont'd)

Sept. 24: LAB ASSIGNMENT 1 - Descriptive statistics and graphs (due on Sept. 30)

Sept. 30: LAB ASSIGNMENT 2 – Distributions (due on Oct. 7)

Oct. 7: LAB ASSIGNMENT 3 - Correlation and regression (due. on Oct. 14)

Oct. 14: LAB ASSIGNMENT 4 - Hypothesis testing (due on Oct. 21)

Oct. 21: No lab

Oct. 28: Introduction to Python

Nov.4: LAB ASSIGNMENT 5 - Multiple measurement methods (due on Nov. 11)

Nov. 11: LAB ASSIGNMENT 6 - Random walk modelling (due on Nov. 18)

Nov. 18: FINAL PROJECT Part. 1 - Analysis of climate time series

Nov. 25: FINAL PROJECT Part. 2 - Analysis of climate time series (due date to be determined)

Dec. 3: No lab

N.B. #1: Please note that it is during lab sessions that you will be able to get the most help from the instructional team. It is not guaranteed that the instructors will be available outside of those periods to help you navigate the nitty-gritty details of writing code in R or Python. It is also strongly recommended that you use the lab sessions to complete as much of the lab exercises as possible, as this will mean that you have less to do on your own when you leave the classroom.

N.B. #2: Lab assignments are due on the dates indicated above, at the beginning of the lab session (Friday at 2:30 pm or earlier).

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6 Assessments

6.1 Marking Schemes & Distributions

Assessment Type (Matching Learning Outcome, LO)	Weight (%)
Lab assignments (all learning outcomes)	45
Statistics exam (LO5, LO6, LO10)	27.5
Final project (all learning outcomes)	27.5
Total	100

6.2 Assessment Details

Lab Assignments (45%)

Throughout the term, you will have the opportunity to complete 6 lab assignments. Lab assignments will always be due 1 week after they were initiated in class. Each assignment is worth 7.5% of your final grade, for a total of 45% of your overall course grade.

Statistics Exam (27.5%)

The statistics exam will take place on **Oct. 26, between 3:30 an 4:20 pm**, and will cover all materials covered in semester weeks #1 through #6. More information about this online exam and its format will be provided in class in late September. **The statistics exam is mandatory and will be worth 27.5% of your overall course grade.**

Final Project (27.5%)

Contrary to the lab assignments, the final project will span more than one week and will consist in analyzing recent and future projected climate data. The final project will be introduced in class on **Nov. 16** and further elaborated in the lab session on **Nov. 18**. Students can complete the final project on their own time, knowing that additional support will be available during the lab session on **Nov. 25**. **The final project is mandatory and will be worth 27.5% of your overall course grade.**

6.3 Dropbox Submissions

All lab assignments, as well as the final project report, should be submitted electronically via the online Dropbox tool available from CourseLink. When submitting your assignments or reports using the Dropbox tool, do not leave the page until your work has successfully uploaded. To verify that your submission was complete, you can view the submission history immediately after the upload to see which files uploaded successfully. The system will also email you a receipt. Save this email receipt as proof of submission.

If, for some reason, you have a technical difficulty when submitting your work electronically, please contact an instructor or CourseLink Support.

http://spaces.uoguelph.ca/ed/contact-us/

6.4 Grades and Feedback

Your assignments will be graded, and feedback posted online within two weeks of each submission deadline.

At the end of the term and after the final exam period has ended, as a University of Guelph student, you will be able to access your final course grade by logging into WebAdvisor (using your U of G central ID).

https://webadvisor.uoguelph.ca

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7 Course Statements

7.1 Communication

You are required to check your uoguelph email on a regular basis, as important messages related to this course may be sent from CourseLink. You are also required to check the course website (CourseLink) regularly for special announcements, new documents to download, etc. The course instructors will do their best to answer emails within 48 hours (weekends and holidays excepted). However, you should remember that the best time to communicate with the instructors is during class time.

7.2 Group Work

With regards to lab assignments and the final project, while you are allowed to discuss your methodology with fellow students, the written reports that you hand in should be your own. Two (or more) students who submit work that appears too similar will be subjected to an academic misconduct investigation. **Make sure that you aware of and abide to the University's academic integrity principles (refer to section 8.6 of this course outline)**.

7.3 Late Work

All assignments (lab assignments and final project) are to be submitted to the instructors, via CourseLink (Dropbox, see section 6.3 of this course outline), on or before the due date. Email submissions will **not** be accepted unless agreed upon ahead of time with the instructor. All late work will receive a 10% deduction for each day, or part thereof, that they are late, up to a limit of five (5) days. Work that is 6 days late or more is guaranteed to receive a failing grade. Extensions will only be considered for medical reasons or other extenuating circumstances, provided that they are discussed with the instructor well before the due date. Extensions will not be granted once the due date has passed.

You should remember that a technical difficulty is not a valid excuse to turn in an assignment late. Don't wait until the last minute as you may get behind in your work. Be sure to keep a back-up copy of all your assignments: to avoid any last-minute computer problems, save your assignments to a cloud-based file storage (e.g., Google Docs, OneDrive) or send copies to your email account so that should something happen to your computer, your assignment can still be submitted on time or re-submitted. Please note that these rules are not designed to be

arbitrary, nor are they inflexible: they are designed to keep you organized, to ensure that all students have the same amount of time to work on assignments, and to help the instructor return marked materials to you in the shortest possible time.

8 University Statements

8.1 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.

8.2 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

8.3 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

8.4 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.

8.5 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 make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

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

8.6 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

8.7 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.

8.8 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

8.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (https://news.uoguelph.ca/2019-novel-coronavirus-information/) and circulated by email.

8.10 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

8.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/
- https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.

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