



ENVR 4000 / GEOG 7010 – Fall 2023
Data Science with R for Environmental Research

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Office:	Working remotely
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Office Hrs:	Online by appointment. Please email to set a time
Classes	2:30-5:25 p.m. Tuesdays, ST. JOHN'S COLLEGE Rm: 205 and/or via Zoom

1 Description

R is quickly becoming the go-to tool for statistics and data analysis in many fields and environmental research is not immune to this trend. Whether you are about to enter a job market increasingly driven by big data and the need to make sense of it, or a graduate student looking for efficient and reproducible ways to analyze your data, being familiar with R and how to properly use it will make your future so much easier.

The aim of this course is to familiarize the student with R and a number of support tools that will allow you to more effectively and efficiently apply data science and statistical principles learnt elsewhere to your data. Only basic knowledge of statistics is required for this course, as the focus is on R. This course will make use of the power of RStudio and the plethora of tools in the Tidyverse to guide the student through the whole process from data collection (including good practices on data organization) to reporting and everything in between, always with the goals of transparency and reproducibility. Principles of project-oriented workflows, functional programming, version control (via Git and GitHub), as well as notions of R-Markdown will be included.

2 Learning outcomes

- Students will be able to plan a data collection and recording strategy that facilitates computational analysis, maximizes reproducibility and shareability, and minimizes the chances of introducing non-traceable errors and data loss
- Students will be able to conduct data clean-up, preparation, analysis, visualization, and reporting in a reproducible, sharable workflow using R and R studio
- Students will incorporate project-oriented workflows, as well as version-control approaches to their data analysis
- Being “fully bilingual” in R is a life-long goal, in the short/mid-term, sourcing answers (mainly online) to how to do things with R is an intrinsic part of the process. After this course the students will be familiar with trust-worthy, up-to-date, and reliable sources for these answers which will limit the time waster trying to implement, outdated, or just plain wrong approaches.

3 Course literature

There is no individual source we will follow, but the contents of this course will be heavily based on those in these sources, which we might refer to throughout the course.

Wickham, H., Golemund, G., (2017). R for Data Science: Import, Tidy, Transform, Visualize, and Model Data. O'Reilly Media, Inc. (available online for free: <https://r4ds.had.co.nz>)

Bryan, J. (2020). Happy Git and GitHub for the useR (available online for free: <https://happygitwithr.com>)

Wickham, H. (2017). ggplot2: Elegant Graphics for Data Analysis (available online for free: <https://ggplot2-book.org>)

Bryan, J. & Hester, J. (2020). What They Forgot to Teach You About R. available online for free: <https://rstats.wtf>)

Wickham, H. 2017. The tidyverse style guide. (available online for free: <https://style.tidyverse.org>)

NOTE: This course is **heavily** inspired by the **STAT 545** course created by Jenny Bryan at UBC. She does not teach the course anymore as she has since moved on to be Software engineer at RStudio, however she still maintains a parallel site with the contents of her vision for that

course. These contents are still updated regularly and are available here: <https://stat545.com> (the actual Stat 545 course is still available and healthy at UBC with new fantastic teachers). We will use some of her materials for this course. Just like with code, as long as you properly acknowledge your sources, there is no need to re-invent the wheel. Specially if it is already a pretty good wheel!

4 Other resources

- RStudio cheat sheets: available online for free: <https://rstudio.com/resources/cheatsheets>. I specially recommend you download and have handy the following:
 - RStudio IDE Cheat sheet
 - Base R (for reference, available among the contributed ones)
 - Data Visualization Cheat sheet (ggplot2)
 - Data Transformation Cheat sheet (dplyr)
 - Data Import Cheat sheet (readr)
 - Dates and Times Cheat sheet (lubridate)
 - Apply Functions Cheat sheet (purrr)
 - Work with Strings Cheat sheet (stringr)
 - R Markdown Cheat sheet (rmarkdown)
 - Shiny Cheat sheet (shiny)
- Tidyverse resources: In depth info about all the tidyverse packages (<https://www.tidyverse.org>)
- Other useful packages:
 - Patchwork: For combining multiple ggplot plots (<https://patchwork.data-imaginist.com>)
 - Janitor: Assortment of tools to clean datasets (<https://github.com/sfirke/janitor>)

5 Camera/microphone policy during Zoom classes

Parts of this course may be delivered online via Zoom. As a teacher, seeing your students is important for many reasons, but more important than that is the fact that everybody should be entitled to keep the privacy of their homes. **Having your camera/mic on is NOT a requirement**, however, I will have my camera on, and you are more than welcome to do it as well. For discussion pieces and question periods, it is always easy to speak through a mic, but zoom has a fantastic chat tool that you are more than welcome to use. In fact, sometimes, it just works better!

I do acknowledge the fact that without a camera and mic on it becomes easy for those of you listening to not pay attention to the class or just do something else. Believe me, after over 2 years of zoom meetings, I have been there myself. I do hope that everybody joining this course is doing it for the right reasons and that learning is the main one. Contents during synchronous lectures will be provided afterwards. If you miss it in the lecture, it will be up to you to catch up. If you don't, I will know in the assignments and exam and it will only hurt your mark.

6 Grading scheme:

Item	Weight	Notes
Attendance and Participation	10%	-5% for each unjustified absence*
Weekly homework	25%	-5% for each delayed or not submitted piece
Weekly Tidyuesday commentary	15%	-5% for each delayed or not submitted piece
Tidyuesday Assignment	20%	
Take home Exam	30%	

* Accommodations can be made upon request

7 Final grade allocation

A+	90% or above	C+	65% - 69%
A	80% - 89%	C	60% - 64%
B+	75% - 79%	D	50% - 59%
B	70% - 74%	F	49% or below

8 COURSE SCHEDULE

The following is the tentative schedule and order of material to be covered in the class. Dates and material may change.

Week	Class date	First half of class	Second half of class
1	2023-09-12	Intro	Git and GitHub
2	2023-09-19	Tidy data	Rstudio set up and projects
3	2023-09-26	RStudio set up and projects II	Base R, objects and I/O
4	2023-10-03	Base R, objects and I/O II	Tidyverse
5	2023-10-10	R Markdown / Quarto and {here}	Quick Intro to ggplot
6	2023-10-17	ggplot basics	ggplot - themes and scales
7	2023-10-24	ggplot - annotations	ggplot - multiplots
8	2023-10-31	Working with dates	Merging and joining datasets
9	2023-11-07	Data exploration and counting	Working with strings
10	2023-11-14	No class - fall break	No class - fall break
11	2023-11-21	Working with model outputs	The magic of {purrr}
12	2023-11-28	Conditionals, loops and more	Geospatial data with R
13	2023-12-05	Animated and interactive plots	Review
14	2023-12-12	No class - Take-home exam	No class - Take-home exam

9 Evaluation schedule

The following shaded boxes indicate when items are **DUE**

Week	Class date	Homework	Tidyuesday commentary	Tidyuesday assignment	Take-home Exam
1	2023-09-12				
2	2023-09-19				
3	2023-09-26				
4	2023-10-03				
5	2023-10-10				
6	2023-10-17				
7	2023-10-24				
8	2023-10-31				
9	2023-11-07				
10	2023-11-14				
11	2023-11-21				
12	2023-11-28				
13	2023-12-05				
14	2023-12-12				

10 Student responsibilities

- Students are required to attend all assigned synchronous lectures. Students are expected to be punctual for synchronous classes.
- Students are required to complete the necessary assignments individually and on time, unless otherwise stated.

11 Voluntary withdrawal date

The voluntary withdrawal date is the last date for withdrawing from this course without academic penalty. The voluntary withdrawal date for this course is **November 21, 2023**.

Evaluative feedback will be provided prior to this date.

12 Evaluation items

12.1. *Take home exam*

You will have one week from handout date to complete the take home exam. A mark of **zero** will be given to any exam that is handed in late unless permission is granted prior to the deadline. Please see list below for acceptable and unacceptable reasons for rewriting the take home exam (which will be a new and different exam with a one-week window to write).

Reasons for granting an extension: a death in your immediate family, a significant illness in either yourself or in a dependent. Students who are unable to meet a course requirement due to medical circumstances are **currently not required to submit medical notes**. However, students are required to contact their instructor or academic advisor by email to inform of the missed work and to make arrangements for extensions, deferrals, or make-up assignments. Please follow these guidelines if you are unable to meet an academic requirement for your courses.

- Contact your instructor for term work such as a class, quiz, midterm/test, assignment, lab;
- Contact an advisor in your faculty/college/school of registration for a missed final exam (scheduled in the final examination period);
- Inform your instructor/advisor as soon as possible do not delay. Note for final exams, students must contact within 48 hours of the date of the final exam; and
- Email your instructor/advisor from a U of M email address, and include your full name, student number, course number, and academic work that was missed.

Reasons for not granting an extension: having another assignment due at a similar time/day, being away from the university for a personal reason (i.e. holiday or personal vacation), being too busy with other course work (i.e. having a midterm that same day or week), computer is not working properly and/or you lost the exam, or any other reason deemed inappropriate by the instructor. This is not an exhaustive list. Please do not ask for an extension if any of these or similar reasons apply. If you know that you will be away, you **MUST** submit the assignment before the due date.

12.2. *Weekly homework Assignments*

Assignment submission and grading will take place in GitHub (<https://github.com>). This is part of the course program, as becoming familiar with the use of this tool is one of the learning outcomes. The student will need to create a GitHub account, but this process will be part of the first lecture.

Assignments must be submitted to GitHub on time – by 11:59 pm on due date. A penalty of 5% will be given to any non-submitted assignment or late assignment unless the student has obtained Instructor approval 48 hrs in advance of the deadline.

12.3. *Weekly #TidyTuesday commentary*

Starting on week 4 the students will have to submit a weekly commentary based on the **#TidyTuesday twitter event**. #TidyTuesday is a weekly twitter-based event run by @R4DScommunity where every week a different public dataset is made available. Through the week, people can post their own analysis/figures/models done on that dataset under the hashtag #TidyTuesday.

Students will need to follow the discussion on #TidyTuesday and weekly write a short report highlighting interesting code usage, figures or other R-related work by people posting in Titter.

Posting and active engagement in twitter is not necessary, however, twitter requires the user to have an account in order to see the post, so students will need to create one if they don't already have one.

Weekly commentary must be submitted to GitHub on time – by 11:59 pm on due date. A penalty of 5% will be given to any non-submitted assignment or late assignment unless the student has obtained Instructor approval 48 hrs in advance of the deadline.

12.4. *Week 8 #TidyTuesday assignment*

On week 8, we will all privately partake in the **#TidyTuesday twitter event**. As the assignment for this week, the students will have to work on the dataset of the week. Just like the #TidyTuesday event itself, this is a free-form assignment where the student will be free to

generate whichever product they want, as long as it makes use of the R concepts/approaches and tools we would have seen in class by then.

Posting and active engagement in twitter is not required. The student is, however, free to contribute their product to the #TidyTuesday event on Twitter if they so choose.

A private version of their work must be submitted to GitHub on time – by 11:59 pm on due date. A penalty of 5% will be given to any non-submitted assignment or late assignment unless the student has obtained Instructor approval 48 hrs in advance of the deadline.

13 Course policies

Audio/Video Recording: Unless otherwise noted, Dr. Jose Luis Rodriguez Gil, and the University of Manitoba hold copyright over the course materials, presentations and lectures which form part of this course. No audio or video recording of lectures or presentations is allowed in any format, openly or surreptitiously, in whole or in part without permission by Dr. Jose Luis Rodriguez Gil. Course materials (both paper and digital) are for the participant's private study and research and are not to be shared online or distributed.

Feedback: Formative (i.e. comments) and summative (i.e. grade) feedback will be provided to the student within two weeks of the assignment deadline (or as soon as possible). Comments on assignments will be provided via GitHub while mark will be provided via UMLearn.

Questions/Concerns: If you are having a problem and want to discuss something, please feel free to see me before/after the online class or make an appointment at a more convenient time.

Emails: Ensure that the course name and number are included in the subject line for all emails. Please make sure emails are written in a professional manner, including complete sentences. Emails must be sent from University of Manitoba email accounts; emails from other accounts (such as Gmail) will not be responded to. Emails will typically be responded to during regular office hours.

Academic Integrity: Academic dishonesty (plagiarism, cheating) is a very serious matter in any academic institution and is dealt with severely at the University of Manitoba.

Plagiarism or any other form of cheating in examinations, term tests or academic work is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university).

Cheating in examinations or tests may take the form of copying from another student or bringing unauthorized materials into the exam room (e.g., crib notes, pagers or cell phones). Exam cheating can also include exam personation (see below). A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty, including a grade of zero on the assignment/exam, a final grade of F in the course or expulsion from the University (based on severity of offense).

To plagiarize is to take ideas or words of another person and pass them off as one's own. In short, it is stealing something intangible rather than an object. Plagiarism applies to any written work, in traditional or electronic format, as well as orally or verbally presented work. Obviously, it is not necessary to state the source of well-known or easily verifiable facts, but students are expected to appropriately acknowledge the sources of ideas and expressions they use in their written work, whether quoted directly or paraphrased. This applies to diagrams, statistical tables and the like, as well as to written material, and materials or information from Internet sources. IF these are required, students must use either APA or Chicago styles to properly reference work, unless otherwise indicated on the assignment/paper/exam. Students will be penalized 20% if another style or footnotes are used in the assignment. Information on the acceptable styles is available through the UM Libraries at: <http://libguides.lib.umanitoba.ca/c.php?g=298394>

To provide adequate and correct documentation is not only an indication of academic honesty but is also a courtesy, which enables the reader to consult these sources with ease. Failure to provide appropriate citations constitutes plagiarism. It will also be considered plagiarism and/or cheating if a student submits a term paper written in whole or in part by someone other than him/herself or copies the answer or answers of another student in any test, examination, or take-home assignment.

Working with other students on assignments, laboratory work, take-home tests, or on-line tests, when the instructor does not permit this, can constitute Inappropriate Collaboration and may be subject to penalty under the Student Discipline By-Law.

An assignment that is prepared and submitted for one course should not be used for a different course. This is called “duplicate submission” and represents a form of cheating because course requirements are expected to be fulfilled through original work for each course.

Please familiarize yourself with the University policy on academic dishonesty found on the following website:

http://www.umanitoba.ca/student/resource/student_advocacy/cheating_plagiarism_fraud.html.

When in doubt about any practice, ask your professor or instructor.

Examinations Personations is when a student who arranges for another individual to undertake or write any nature of examination for and on his/her behalf, as well as the individual who undertakes or writes the examination, will be subject to discipline under the university’s Student Discipline Bylaw, which could lead to suspension or expulsion from the university. In addition, the Canadian Criminal Code treats the personation of a candidate at a competitive or qualifying examination held at a university as an offence punishable by summary conviction. Section 362 of the code provides:

Personation at Examination

362. Everyone who falsely, with intent to gain advantage for him/herself or some other person, personates a candidate at a competitive or qualifying examination held under the authority of law or in connection with a university, college or school or who knowingly avails him/herself of the results of such personation is guilty of an offence punishable on summary conviction. 1953-54, c.51, s.347.

Both the personator and the individual who avails him/herself of the personation could be found guilty. Summary conviction could result in a fine being levied or up to two years of imprisonment.

A complete copy of the Final Examination Procedures is available at:

http://umanitoba.ca/admin/governance/governing_documents/academic/final_examinations_procedures.html

Students are encouraged to review the University policy on Responsibilities of Academic Staff with Regards to Students (ROASS):

umanitoba.ca/admin/governance/governing_documents/students/278.html

14 Special needs

Students with disability-related needs or are experiencing difficulty should discuss issues with a councillor in one of the following Student Affairs offices as soon as possible. You can also discuss any issues with your instructor, who can direct you to appropriate institutional resources.

- Student Accessibility Services: 155 University Center, 204-474-6213, 204-474-9790 (TTY)
- Learning Assistance Center: 201 Tier Building, 204-480-1481
- Student Counselling and Career Centre: 474 University Center, 204-474-8592

15 Using copyrighted material

Please respect copyright. We will use copyrighted content in this course. I have ensured that the content I use is appropriately acknowledged and is copied in accordance with copyright laws and University guidelines. Copyrighted works, including those created by me, are made available for private study and research and must not be distributed in any format without permission. Do not upload copyrighted works to a learning management system (such as UM Learn), or any website, unless an exception to the Copyright Act applies or written permission has been confirmed. For more information, see the University's Copyright Office website at <http://umanitoba.ca/copyright/> or contact um_copyright@umanitoba.ca.

16 University policies and procedures

A list of academic supports available to Students:

16.1. *Writing and Learning Support*

The Academic Learning Centre (ALC) offers services that may be helpful to you throughout your academic program. Through the ALC, you can meet with a learning specialist to discuss concerns such as time management, learning strategies, and test-taking strategies. The ALC also offers peer supported study groups called Supplemental Instruction (SI) for certain courses that students have typically found difficult. In these study groups, students have opportunities to ask questions, compare notes, discuss content, solve practice problems, and develop new study strategies in a group-learning format.

You can also meet one-to-one with a writing tutor who can give you feedback at any stage of the writing process, whether you are just beginning to work on a written assignment or already have a draft. If you are interested in meeting with a writing tutor, reserve your appointment two to three days in advance of the time you would like to meet. Also, plan to meet with a writing tutor a few days before your paper is due so that you have time to work with the tutor's feedback.

These Academic Learning Centre services are free for U of M students. For more information, please visit the Academic Learning Centre website at:

<http://umanitoba.ca/student/academiclearning/>

You can also contact the Academic Learning Centre by calling 204-480-1481 or by visiting 201 Tier Building.

16.2. *University of Manitoba Libraries (UML)*

As the primary contact for all research needs, your liaison librarian can play a vital role when completing academic papers and assignments. Liaisons can answer questions about managing citations, or locating appropriate resources, and will address any other concerns you may have, regarding the research process. Liaisons can be contacted by email or phone and are also available to meet with you in-person. A complete list of liaison librarians can be found by

subject: <http://bit.ly/WcEbA1> or name: <http://bit.ly/1tJ0bB4>. In addition, general library assistance is provided in person at 19 University Libraries, located on both the Fort Garry and Bannatyne campuses, as well as in many Winnipeg hospitals. For a listing of all libraries, please consult the following: <http://bit.ly/1sXe6RA>. When working remotely, students can also receive help online, via the Ask-a-Librarian chat found on the Libraries' homepage: www.umanitoba.ca/libraries.

16.3. Referral information for mental health resources and support:

For 24/7 mental health support, contact the Mobile Crisis Service at 204-940-1781. You may also find the following resources helpful:

16.4. Student Counselling Centre

Contact SCC if you are concerned about any aspect of your mental health, including anxiety, stress, or depression, or for help with relationships or other life concerns. SCC offers crisis services as well as individual, couple, and group counselling. Student Counselling Centre: <http://umanitoba.ca/student/counselling/index.html>

474 University Centre or S207 Medical Services

(204) 474-8592

16.5. Student Support Case Management

Contact the Student Support Case Management team if you are concerned about yourself or another student and don't know where to turn. SSCM helps connect students with on and off campus resources, provides safety planning, and offers other supports, including consultation, educational workshops, and referral to the STATIS threat assessment team.

Student Support Intake Assistant <http://umanitoba.ca/student/case-manager/index.html>

520 University Centre

(204) 474-7423

16.6. *University Health Service*

Contact UHS for any medical concerns, including mental health problems. UHS offers a full range of medical services to students, including psychiatric consultation.

University Health Service <http://umanitoba.ca/student/health/>

104 University Centre, Fort Garry Campus

(204) 474-8411 (Business hours or after hours/urgent calls)

16.7. *Health and Wellness*

Contact our Health and Wellness Educator if you are interested in information on a broad range of health topics, including physical and mental health concerns, alcohol and substance use harms, and sexual assault.

Health and Wellness Educator <http://umanitoba.ca/student/health-wellness/welcome.html>

Katie.Kutryk@umanitoba.ca

469 University Centre

(204) 295-9032

Live Well @ UofM

For comprehensive information about the full range of health and wellness resources available on campus, visit the Live Well @ UofM site: <http://umanitoba.ca/student/livewell/index.html>

16.8. *Your Rights and Responsibilities*

As a student of the University of Manitoba you have rights and responsibilities. It is important for you to know what you can expect from the University as a student and to understand what the University expects from you. Become familiar with the policies and procedures of the University and the regulations that are specific to your faculty, college or school.

The Academic Calendar <http://umanitoba.ca/student/records/academiccalendar.html> is one important source of information. View the sections University Policies and Procedures and General Academic Regulations. While all of the information contained in these two sections is important, the following information is highlighted.

- If you have questions about your grades, talk to your instructor. There is a process for term work and final grade appeals. Note that you have the right to access your final examination scripts. See the Registrar's Office website for more information including appeal deadline dates and the appeal form <http://umanitoba.ca/registrar/>
- You are expected to view the General Academic Regulation section within the Academic Calendar and specifically read the Academic Integrity regulation. Consult the course syllabus or ask your instructor for additional information about demonstrating academic integrity in your academic work. Visit the Academic Integrity Site for tools and support <http://umanitoba.ca/academicintegrity/> View the Student Academic Misconduct procedure for more information.

16.9. Respectful Work and Learning Environment

The University is committed to a respectful work and learning environment. You have the right to be treated with respect and you are expected conduct yourself in an appropriate respectful manner. Policies governing behavior include the:

16.10. Respectful Work and Learning Environment

Please refer to the document:

http://umanitoba.ca/admin/governance/governing_documents/community/230.html

16.11. Student Discipline

Please refer to the document:

http://umanitoba.ca/admin/governance/governing_documents/students/student_discipline.html

16.12. *Violent or Threatening Behaviour*

Please refer to the document:

http://umanitoba.ca/admin/governance/governing_documents/community/669.html

16.13. *Sexual Assault*

If you experience Sexual Assault or know a member of the University community who has, it is important to know there is a policy that provides information about the supports available to those who disclose and outlines a process for reporting. The Sexual Assault policy may be found at: http://umanitoba.ca/admin/governance/governing_documents/community/230.html More information and resources can be found by reviewing the Sexual Assault site

<http://umanitoba.ca/student/sexual-assault/>

16.14. *Intellectual Property*

For information about rights and responsibilities regarding Intellectual Property view the policy

http://umanitoba.ca/admin/governance/media/Intellectual_Property_Policy_-_2013_10_01.pdf

For information on regulations that are specific to your academic program, read the section in the Academic Calendar and on the respective faculty/college/school web site

<http://umanitoba.ca/faculties/>

Contact an Academic Advisor within our faculty/college or school for questions about your academic program and regulations <http://umanitoba.ca/academic-advisors/>

16.15. *Student Advocacy*

Contact Student Advocacy if you want to know more about your rights and responsibilities as a student, have questions about policies and procedures, and/or want support in dealing with academic or discipline concerns.

<http://umanitoba.ca/student/advocacy/>
520 University Centre
204 474 7423
student_advocacy@umanitoba.ca