Western Science

Department of Statistical and Actuarial Sciences

STATS 4864/9864A: Advanced Statistical Computing
Course Outline

1. Course Information

Course Information
Lectures -- Monday, Wednesday, and Friday 10:30-11:30am in FNB-1270

List of Prerequisites
Statistical Sciences 2864A/B and Statistical Sciences 3859A/B.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites

2. Instructor Information

Instructors	Email	Office	Phone	Office Hours
Dr. Simon Bonner	sbonner6@uwo.ca	WSC 276	519-661-2111 Ext 88205	TBD

Communication
Please use the Forums on the OWL site to post questions about course material. This helps other students who may have the same question, and I encourage you to help each other if you can. Note that you can use LaTeX to insert mathematical equations into your forum posts.

Please send me an e-mail if you need to discuss personal matters (e.g., a missed assignment). I recommended that you use your Western (@uwo.ca) email address.

3. Course Syllabus, Schedule, Delivery Mode

Course Calendar Description
Review of fundamental concepts in statistical computing, including programming, optimization methods and Monte Carlo simulations. A selection of advanced topics such as bootstrapping, robust methods, statistical graphics, Markov chain Monte Carlo, nonlinear regression, relational databases, time series analysis, and spatial statistics.

Course Description

The term "statistical computing" means very different things to different people (statisticians, data scientists, and practitioners). On one hand, statistical computing involves the more abstract aspects of developing and evaluating numerical algorithms required to conduct statistical inference when analytical solutions are not available. On the other hand, it refers to the practicalities of implementing these procedures in modern software packages and on developing good programming skills. This class will attempt to cover some elements of both. The lectures be divided into two approximately equal halves and teach aspects of both applied and theoretical computing. We will begin by learning advanced aspects of the R statistical software environment and key packages including:

- Visualizing data with ggplot
- Transforming and tidying data with dplyr
- Importing data with readr
- Writing your own R functions
- Creating documents with Quarto
- Authoring R packages
- Maintaining software and collaborating with Git

Following this we will cover fundamental methods of computing including:

- Numerical optimization
- The EM algorithm
- Numerical integration
- Simulation
- Bootstrapping
- Markov chain Monte Carlo

Key Dates

Classes begin: September 7, 2023
National Day of Reconciliation: September 29, 2023 (no lecture)
Thanksgiving: October 9, 2023 (no lecture)
Fall Reading Week: October 30 – November 5, 2023
Classes end: December 8, 2023

Schedule and Delivery Mode

The method of delivery will vary depending on the content of a day's class. Some material will be delivered through lectures, some through hands-on work, and some by a combination of the two. Please bring your laptop to every lecture, and make sure it has sufficient battery power remaining, so that you are ready to work.

Contingency plan

Although the intent is for this course to be delivered in person, should any university-declared emergency require some or all of the course to be delivered online, either synchronously or asynchronously, the course will adapt accordingly. The grading scheme will **not** change. Any assessments affected will be conducted online as determined by the course instructor.

4. Course Materials

Readings will be assigned from the following sources:

1. Byran, J. and Hester, J. (2022) Happy Git and GitHub for the useR. Available online at https://happygitwithr.com/index.html
2. Givens, G.H. and Hoeting, J.A. (2012) Computational Statistics. 2nd edition. Wiley & Sons, Inc. Available online at https://ebookcentral.proquest.com/lib/west/detail.action?pq-origsite=primo&docID=1120265
3. Wickham, H. and Bryan, J. (2023) R Packages. 2nd Edition. O'Reilly Media, Inc. Available online at https://r-pkgs.org/.
4. Wickham, H., Cetinkaya-Rundel, M., and Grolemund, G. (2023) R for Data Science. 2nd Edition. O'Reilly Media, Inc. Available online at https://r4ds.hadley.nz/

These materials are all accessible through the Course Readings tool on the OWL site, as well as online through the links provided above. Students are responsible for checking the course OWL site (http://owl.uwo.ca) on a regular basis for news and updates. If you need assistance with the course OWL site, please check the OWL Help page or contact the Western Technology Services Helpdesk at 519-661-3800 or ext. 83800.

Technical Requirements
You must bring a laptop with R version 4.3.1 or newer installed to every lecture. Please speak with me immediately if you do not have access to a laptop.

You are welcome to use any operating system (Windows, MacOS, Linux, or BSD). However, you must have sufficient privileges to install packages in R and further software required during the semester (e.g., Git).

I will work in RStudio during the lectures in expect most of you will do the same. If you do use RStudio then you must have installed version 2023.06.1+524 or later. However, you are welcome to use any development environment.

5. Methods of Evaluation

STAT 4864A
The overall course grade will be calculated as listed below:

Assignments (5)	90%	(18% each)
Presentation Grading	10%	

STAT 9864A
The overall course grade will be calculated as listed below:

Assignments (5)	70%	(14% each)
Presentation	20%	
Presentation Grading	10%	

Assignments
The following is a tentative list of the topics and due dates for each assignment. Exact details will be provided at least two weeks before the due date for each assignment. Assignments will be posted on OWL and solutions will be made available as soon as possible.

- Assignment 1: October 2
  - Data Visualization
  - Data Transformation
  - Data Tidying
  - Data Import

- Assignment 2: October 16
  - Functions
  - Quarto
  - R Packages

- Assignment 3: November 6
  - Github
  - Univariate Optimization

- Assignment 4: November 20
  - Multivariate Optimization

- Assignment 5: December 4
  - Numerical Integration
  - Simulation
  - Bootstrapping

Graduate Student Presentations
Details will be provided separately.

6. Student Absences

Attendance at lectures is not required, though I will record attendance for my own information. If you miss a lecture then it is your responsibility to check with your classmates to find out what material you missed. If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

STAT 4864A
Each assessment in this course is worth more than 10% of the final course grade and so you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible if you are unable to submit an assignment or the final project on time. For further information, please consult the University's medical illness policy at

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf.

The Student Medical Certificate is available at

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

If accommodation is granted then you will be able to submit your assignment or the final project late without penalty. The length of the accommodation will be determined by the academic counsellor.

Assignments that are submitted late without an extension or past the extension deadline will be penalized 10% per day up to 5 days. Assignments submitted past this point will receive a grade of 0.

STAT 9864A
Please speak with me as soon as possible if you are not able to submit an assessment on time. Assignments that are submitted late without an extension or past the extension deadline will be penalized 10% per day up to 5 days. Assignments submitted past this point will receive a grade of 0.

6. Accommodation and Accessibility

Religious Accommodation
When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at

https://multiculturalcalendar.com/ecal/index.php?s=c-univwo.

Accommodation Policies
Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf.

7. Academic Policies

The website for Registrarial Services is http://www.registrar.uwo.ca.

In accordance with policy,

https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf,

the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

8. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.uwo.ca/sci/counselling/.

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (https://learning.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: https://www.uwo.ca/se/digital/.

Additional student-run support services are offered by the USC, https://westernusc.ca/services/.