

# Advanced Statistical Computing

## Statistical Sciences 4864A/9864A

*Department of Statistical and Actuarial Sciences*

*University of Western Ontario*

### Course Outline

#### Course Information

**Lecture Hours:** MWF 10:30-11:30 AM, WSC 248

**Pre, Co-requisites Warning:**

Previous programming experience required. Eagerness to learn R/RStudio including Markdown/Notebook for document preparation as well as some other computing topics.

*Undergraduate Students*

Prerequisite: A minimum of 60% in SS2864 and SS3859

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. You can be deregistered at any time even after writing the final exam. 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.

*Graduate Students*

Enrolled in the graduate program in the Department of Statistics and Actuarial Sciences at Western (Statistics, Actuarial Science, Financial Modelling, Biostatistics) and have taken a first course in mathematical statistics using calculus and linear algebra. Good understanding of linear equations and basic mathematics including algebra and geometry. A previous course in computing.

#### Instructor Information

Instructor: Dr. Jingjia Chu

Email: [jchu223@uwo.ca](mailto:jchu223@uwo.ca)

Office Hours and Location: TBA on Tue and Thu afternoons

Students must use their Western (@uwo.ca) email addresses when contacting their instructors with proper email title (starts with 'SS4864' for undergraduate and 'SS9864' for graduate).

For discussions on lectures/course material please see your instructor during the scheduled office hours. The students are expected to use office hours under normal circumstances unless you have concerns on your administration, e.g. midterm/assignment gradings. **All concerns need to be emailed to the**

**instructor no later than a week after posting online. Discussions and questions should be posed either in class, immediately after class, or during afternoon office hours.**

You can expect a response to your email within about 48 hours during the Monday to Friday work week. Note that emails will generally not be answered, nor office hour will be scheduled within the 24-hour period before exams; this is meant to encourage proactive studying and help-seeking behaviour.

## **Course Description**

Review of fundamental concepts in statistical computing, including programming, numerical 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, statistical learning, time series analysis, and spatial statistics.

The course evaluation will be divided into 5 components: assignments, participation/attendance, survey, midterm and course project.

## **Course Objectives**

This course introduces students to ways of implementing various statistical procedures in R. For computation intensive procedures, C programming and R to C interface will be introduced. The aim is to gain a good understanding of how to efficiently use packages to perform data analysis. The approach will be research-orientated and therefore students will learn in detail how various statistical procedures are implemented. If time permits, SAS macro and Python programming will be discussed. Topics covered though not restrict to those will include:

Data preprocessing (tidyverse, graphs)

MLE, Inference including hypothesis tests, bootstrap, and MCMC

Regression (simple, multiple, glm, smoothing, etc)

Statistical parallel computing

SAS macro/Python programming (time permits)

## **Course Materials**

There is no required textbook. Topics from two textbooks will be discussed.

- (i) Modern Applied Statistics with S. 4th edition, Springer by Venables, W.N. and Ripley, B.D. (2002)
- (ii) R for Data Science by Wickham and Grolemund, <http://r4ds.had.co.nz/>

Software needed:

A personal computer that has R and RStudio installed (Windows, Mac, Linux) is highly recommended since they are required to complete the assignments. The majority of the course will be in R while there

might be SAS, Python coding involved in the later part of the course if time permits. Computers with R, RStudio, SAS and Python installed are also available in the Department Computing Lab (WSC 258).

Course Website (OWL): <https://owl.uwo.ca>

Students should check OWL (<http://owl.uwo.ca>) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class. Students are responsible for checking OWL on a regular basis.

**Check the course webpage before class. Course slides will be posted with outlines only and the missing part will be presented during class.**

The detailed notes will not be posted at any time. You could only request the missing notes from your instructor given proper documentation provided (approval from the Dean's office for illness or non-illness absence).

#### Important Notes:

Ask your Instructor before you make an audio recording of class. This expectation provides basic respect for their privacy and personal safety and is in keeping with Intellectual Property rights. If you would like to make audio recordings of our lecture sessions, please send an email to me.

Course material (i.e. lecture slides, videos, and other supplementary material posted on the course website and discussed in class) is the intellectual property of your instructor and is made available to you for your personal use in this course. Sharing, posting or using this material outside of your personal use in this course is considered an infringement of intellectual property rights.

## Course Assessment and Evaluation

### Assignments (25%)

There are about 5 assignments, roughly one every two weeks.

Tentative Dates: Sep 25, Oct 9, Oct 30, Nov 13, Nov 29 (Paper version due in class, email submission due before class)

Assignments must be prepared using RStudio Markdown/Notebook (PDF). Both PDF and RMD (RMarkdown/Notebook) files must be sent to [jchu223@uwo.ca](mailto:jchu223@uwo.ca) as well as the full R Script (.R) file. A printed version also required in class on the due day.

No late assignment is allowed. No copy is allowed. Each submission counts equally (fail either email submission or the paper submission, 2.5% towards the course total will be deducted from that assignment) which need to be received before the due time.

### Survey (2%)

Two surveys (2\*1%) need to be completed before the deadline. If you finish one survey before deadline, you will receive 1% (does not depend on your answers). The survey will be posted on OWL with the deadline and also be announced in class. You will have one week to finish the survey. The purpose of survey is to give you an opportunity to provide feedback, concerns and suggestions to the course and instructor.

Note: There will be a survey in class on the first day. This survey does not count towards any of the evaluation metrics.

## **Midterms or Tests (30%)**

There will be a 2-hour midterm on Nov 2, 3-5 pm

Location:TBA

## **Attendance and Participation (5%)**

The total attendance and participation will be evaluated through the term by different ways, e.g. assignment distribution, call the roll, peer review form. You are allowed with 1 absence only. The final grade for participation will be calculated proportional (the total will be rounded to the first decimal place) and the number of participation check will be 6~10 times. For instance, in case of 7 attendance checks, each attendance will worth 0.833% (5% / 6).

## **Course Project (38%)**

There will be a course project with presentation involved. The maximum number of students in each group will be 2, might change later depends on the number of students enrolled in this course.

The presentation will contribute 15% toward the final grade and be calculated through peer evaluation. The details of the evaluation form will be posted online in October. You will receive the average grades with both side tails removed of your peer and the instructor.

The rest 23% will be graded based on your written project.

Presentation Slides Due: Nov 24 11:59 pm. To be submitted through OWL (pdf or PowerPoint)

Written Project Due: Dec 18 11:59 pm. To be submitted through email with dataset if applicable

Important Note: All email submissions need to be sent to [jchu223@uwo.ca](mailto:jchu223@uwo.ca) with course number and requirement as title (e.g. SS4864 AS1 for undergraduate, SS9864 AS1 for graduate).

## **Accommodation and Accessibility**

### **Accommodation**

Note that if documentation (medical or otherwise) is required, it can only be collected by the students Deans Office/Academic Counselling unit.

If you are unable to meet a course requirement due to illness or other serious circumstances, you must seek approval for the absence as soon as possible. Approval can be granted either through a self-reporting of absence or via the Dean's Office/Academic Counselling unit of your Home Faculty. If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in NCB 280, and can be contacted at [scibmsac@uwo.ca](mailto:scibmsac@uwo.ca).

For further information, please consult the university's policy on academic consideration for student absences:

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/Academic\\_Consideration\\_for\\_absences.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf)

The policy on Accommodation for Religious Holidays can be found here:

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_religious.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf)

If you miss the Final Exam, please contact your faculty's Academic Counselling Office as soon as you are able to do so. They will assess your eligibility to write the Special Exam (the name given by the university to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a “Multiple Exam Situation” (see [http://www.registrar.uwo.ca/examinations/exam\\_schedule.html](http://www.registrar.uwo.ca/examinations/exam_schedule.html)).

It is Faculty of Science policy that a student who chooses to write a test or exam deems themselves fit enough to do so, and the student must accept the mark obtained. Claims of medical, physical, or emotional distress after the fact will not be considered.

### **Policy on Missed Course Requirements**

Missed Assignment and survey: No accommodation will be granted based on the long timeframe given.

Attendance: See above in course assessment and evaluation with no further adjustment.

Missed Midterms: The policy of the department of Statistical and Actuarial Sciences is that there will be no make-up exams for missed midterms or tests. If recommendation for accommodation is received from your Dean's office, the weight of the missed midterm will be replaced with another written project. The grading standard for this make-up project will be adjusted later according to the class average of the midterm, which may not be the same as the course final project. If no recommendation is received, then you will receive a mark of 0 for your midterm.

Course Project: No accommodations will be granted.

### **Accessibility**

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 ext. 82147 for any specific question regarding accommodation.

The policy on Accommodation for Students with Disabilities can be found here:

[www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_disabilities.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf)

## **Academic Policies and Statements**

### ***Statement on Use of Electronic Devices***

No electronic devices except a non-programmable calculator are permitted on the exam.

### ***Statement on Academic Offences***

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 sites:

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_discipline\\_grad.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf)

and

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf)

Computer-marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and **Turnitin.com** ( <http://www.turnitin.com> ).

During tests/exams, proctors will inspect all personal belongings on your desk (and even your baseball cap if you are wearing one). If any items are discovered that are not permitted (e.g. any electronic device other than a non-programmable calculator, or notes) they will be confiscated, and the incident will be officially reported as an academic offence. Proctors have the discretion to move students between desks during the Tests or Exam periods.

### ***Email Security and Communication***

In accordance with policy, <http://www.uwo.ca/its/identity/activatenonstudent.html>, 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 his/her official university address is attended to in a timely manner.

You are welcome to communicate with your instructor by email, but email communication should only be used to provide them with information or to ask a question that requires a brief response. For more lengthy discussions and for discussions on lectures/course material please see your instructor during their scheduled office hours or by appointment. If you do email them, please use your UWO account, as these may be the only emails read.

### ***Attendance***

Classroom attendance is viewed as an important part of the learning process. Students are advised that excessive absenteeism may result in the student being disbarred from the final exam (see Western Academic Calendar).

### ***Classroom Environment***

The Department of Statistical and Actuarial Sciences has adopted a "Mutual Expectations" policy governing the classroom environment and all work submitted by students. The full text of the policy can be found at: <http://www.uwo.ca/stats/undergraduate/mutual-expectations.html>. In summary, the policy was developed under the premise that all interactions between students and faculty should be governed by the principles of courtesy, respect and honesty.

## Support Services

Learning-skills counsellors at the Student Development Centre (<http://www.sdc.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.

Registration Services: <http://www.registrar.uwo.ca> .

Student Support Services (including the services provided by the USC listed here:

<http://westernusc.ca/services/>

Student Development Services: <http://sdc.uwo.ca/>

Students who are in emotional/mental distress should refer to Mental Health@Western

<http://www.uwo.ca/uwocom/mentalhealth/> for a complete list of options about how to obtain help.