

## STATS 4850/9850A Course Outline

### 1. Course Information

#### Course Information

STATS 4850G/9850B – Advanced Data Analysis

#### Lectures

Monday 12:30-1:20 in NCB 293 or HSB 13\* (TBD)  
Wednesday and Friday 12:30-1:20 in NCB 293

\* We will meet in NCB 293 on January 9.

#### List of Prerequisites

A minimum mark of 60% in both Statistical Sciences 3843A/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	<a href="mailto:sbonner6@uwo.ca">sbonner6@uwo.ca</a>	WSC 276	519-661-2111 Ext 88205	TBD
Zhaoqi Yang	<a href="mailto:zyang633@uwo.ca">zyang633@uwo.ca</a>			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](mailto:@uwo.ca)) email address.

### 3. Course Syllabus, Schedule, Delivery Mode

#### Course Description

Modern methods of data analysis including linear and generalized linear models, modern nonparametric regression, principal component analysis, multilevel modelling and bootstrapping.

In a nutshell, this course will focus on two topics:

1. Extension of simple and multiple linear regression models including
  - Random effects
  - Model Selection and Regularization
  - Splines and generalized additive models
2. Methods of Bayesian inference including
  - One and two parameter models
  - Prior selection
  - Regression models
  - Hierarchical models
  - MCMC

We will focus on the applied aspects of these methods looking at how to fit appropriate models using packages R and how to interpret the output, and avoiding the technical aspects of the computational methods underneath as much as possible. We will also practice writing statistical reports.

### **Contingency plan for an in-person class pivoting to 100% online learning**

In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, affected course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will **not** change. Any remaining assessments will also be conducted online as determined by the course instructor.

## **4. Course Materials**

The two primary texts for the course will be:

1. James, G., Witten, D., Hastie, T., Tibshirani, R. (2021). An Introduction to Statistical Learning. Second Edition Springer Texts in Statistics, vol 103. Springer, New York, NY. <https://www.statlearning.com/>.
2. Cowles, Mary K. (2013). Applied Bayesian Statistics With R and OpenBUGS Examples. Springer Texts in Statistics, vol 98. Springer, New York, NY. <https://link-springer-com.proxy1.lib.uwo.ca/book/10.1007/978-1-4614-5696-4>

Both are available for free from the provided links. I will also be posting further references on OWL.

### **Technical Requirements**

You must access to a computer with R version  $\geq 4.1.0$ . You are welcome to use any operating system (Windows, MacOS, Linux, or BSD). However, you must have access to install packages in R and further software required during the semester. I will work in RStudio during the lectures and expect most of you will do the same. However, you are welcome to use any IDE.

## **5. Methods of Evaluation**

### **STAT 4864A**

The overall course grade will be calculated from the following breakdown:

Assignment	75%	(15% each)
Final Project	25%	(10% proposal + 15% final report)

## STAT 9864A

The overall course grade will be calculated as listed below:

Assignments	75%
Final Project	25% (10% proposal + 15% final report)

### Assignments

There will be 5 assignments in the course. Each assignment will be based on the material from two computing labs and will require you to analyse data in R using the methods presented to generate and interpret relevant output. Assignments should be submitted as PDF documents created using RMarkdown (or quarto or knitr). The following is a tentative schedule of the assignment due dates and topics:

- Assignment #1: January 30
  - Linear Regression and Random Effects
  - Writing: Results
- Assignment #2: February 13
  - Spatial Modelling and Cross-Validation
  - Writing: Methods
- Assignment #3: Mar 6
  - Shrinkage Methods, PC Regression, and PLS
  - Writing: Conclusions
- Assignment #4: Mar 20
  - Basis Functions, Regression Splines, and Smoothing Splines
  - Writing: Introduction
- Assignment #5: April 3
  - GAMs and Bayesian inference with brms

Assignments will be due by 11:59pm on the due date. Each assignment will be worth 15% of your final grade.

### Final Project

The final project will require you to select a dataset, conduct an analysis, and write a report summarizing your methods and describing your results and conclusions. The final project will be due in two pieces:

1. Proposal due March 13
2. Final Report due April 28

Further details will be provided during the semester.

## 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 4850G**

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](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](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 accommodation deadline will be penalized 10% per day. Assignments submitted 5 days past the original due date will receive a grade of 0.

I will provide 3 grace days that may be used for any assignment but not the final project (proposal or report). Please notify me when you wish to use one of your grace days.

### **STAT 9850B**

Please let me know as soon as possible if you are unable to submit work on time.

Assignments that are submitted late without an extension or past the accommodation deadline will be penalized 10% per day. Assignments submitted 5 days past the original due date will receive a grade of 0.

I will provide 3 grace days that may be used for any assignment but not the final project (proposal or report). Please notify me when you wish to use one of your grace days.

## **7. 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](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Accommodation_disabilities.pdf).

## 8. 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](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](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf).

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

## 9. 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](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](mailto: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](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/>.