SS3859A/SS9859A Regression
Course Outline – Fall 2024

1. Course Information

Lectures:	Mon/Wed/Fri	1:30 – 2:30 pm	North Campus Building (NCB) 117
Tutorials:	Mon	2:30 – 3:30 pm	North Campus Building (NCB) 117

Prerequisites:

SS3859: A minimum mark of 60% in Statistical Sciences 2858A/B.
Pre- or Corequisite(s): Statistical Sciences 2864A/B.

SS9859: Enrollment in a Department of Statistical & Actuarial Sciences graduate program and the ability to use R statistical software.

Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and Science Academic Advisors) 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

Instructor:	Dr. Douglas Woolford
Email:	dwoolfor@uwo.ca
Office:	Western Science Centre (WSC) 221
Phone:	519-661-2111 ext. 88326
Office Hours:	As announced in class/on OWL and by appointment.

Email is the best way to contact me. Please use your Western (@uwo.ca) email address. Emails will typically be responded to within one business day. If emailing to request an appointment outside of office hours, please suggest a few options that are listed in your order of preference.

3. Course Syllabus, Schedule, Delivery Mode

Calendar Description

Simple and multiple linear regression models and their use to model data using computing including model specification and assumptions, inference and estimation, use of indicator variables, regression diagnostics, model building and selection. Introduction to forecasting and time series.

Course-Level Learning Outcomes

On successful completion of this course, students shall be able to:

- Import and work with data in R, including creating numerical and visual summaries of data that illustrate important features of the data, including distributions, relationships, trends, etc.
- Thoroughly analyze a data set appropriate for linear regression by: i) exploring and cleaning the data; ii) following an iterative model building process for regression including model specification, calibration, adequacy checking, and validation; and, iii) use a regression model to predict new observations, make inferences about the underlying process, and discuss results in a broader scientific context.
- Explain the theoretical details underlying regression models.
- State the assumptions of regression models, identify situations where regression modelling is and is not appropriate and understand the hazards of incorrect model specification, failed modelling assumptions, and extrapolation in the context of scientific/applied studies using regression-based techniques.
- Fit more advanced regression models, such as those incorporating change points, non-linear relationships, autocorrelation, and/or random effects.

Delivery Mode

Lectures: This is an in-person course. You are expected to attend lectures and actively engage in learning the material that is presented.

Tutorials: You are expected to attend tutorials, which will be run in an open format—topics and structure may vary from week-to-week. Possible tutorials include open help sessions, data modelling/computing demonstrations, review, etc. Note that tutorial time could be used to make up missed class time if necessary.

Tentative Schedule

Week	Dates	Topic
1	Sept. 5 – 6	Course information; Overview of statistical modelling and regression
2	Sept. 9 – 13	Introduction to simple linear regression; Estimation techniques for regression model fitting (least-squares, maximum likelihood)
3	Sept. 16 – 20	Properties of estimators and sampling distributions (simple linear regression); F-test for regression; Hypothesis testing and confidence intervals for parameters
4	Sept. 23 – 27	Coefficient of determination; Confidence intervals for the conditional mean; Prediction intervals for new observations
5	Sept. 30 – Oct. 4	Indicator variables; Comparing models; Introduction to multiple regression
6	Oct. 7 – 11	Multiple linear regression, overview and estimation
7	Oct. 14 – 18	Reading week (no classes or tutorials)
8	Oct. 21 – 25	Model adequacy checking and diagnostics; Residuals, outliers, leverage and influence measures
9	Oct. 28 – Nov. 1	Extrapolation; Transformations and weighting
10	Nov. 4 – 8	Model building techniques/variable selection

11	Nov. 11 – 15	Properties of estimators (multiple linear regression); Confidence and prediction intervals
12	Nov. 18 – 22	Sequential sum of squares and nested models; Standardized regression; Multicollinearity; Ridge/LASSO regression
13	Nov. 25 – 29	Regression for time-series data; serial autocorrelation; smoothing (e.g., local regression/spline smoothing)
14	Dec. 2 - 6	Introduction to logistic regression; Summary and review

Important Dates

Sept. 5 Classes begin
Sept. 13 Canada Life Day (No Classes). Last day to add a full-course or a first-term half course or drop a course without showing WDN
Sept. 30 National Day for Truth and Reconciliation (observed at Western). No classes.
Oct. 12-20 Fall Reading Week (including Thanksgiving, Oct. 14). No classes or tutorials.
Dec. 2 Last day to withdraw from a first-term half course or full-year course without academic penalty *(extended from Sat. Nov. 30)*
Dec. 6 Last day of classes in the Fall term
Dec. 7-8 Study Days
Dec. 9–22 Examination period

4. Course Materials

Course Textbook:

- Montgomery, D. C., Peck, E. A., & Vining, G. G. (2021). *Introduction to Linear Regression Analysis*, 6th Ed. John Wiley & Sons

Supplementary References:

Regression

- Abraham, B., & Ledolter, J. (2006). *Introduction to Regression Modeling.* Thomson Brooks/Cole.
- Faraway (2005). *Linear Models with R.* Chapman & Hall/CRC press.
- Faraway, J. J. (2002). *Practical regression and ANOVA using R.* https://cran.r-project.org/doc/contrib/Faraway-PRA.pdf
- Sheather, S. (2009). *A modern Approach to Regression with R*. Springer.

R Software and Programming

- Venables, W. N., & Team, R. C. (2017). *An Introduction to R Notes on R: A Programming Environment for Data Analysis and Graphics.* https://cran.r-project.org/doc/manuals/R-intro.pdf
- Braun, W. J., & Murdoch, D. J. A first course in statistical programming with R. Cambridge University Press (1st Ed. 2008; 2nd Ed. 2016).

Probability and Statistics (pre-requisite material)

- Devore, J.L. and Berk, K.N. (2012). Modern Mathematical Statistics with Applications,2nd Ed. Springer. (An e-version is available online through Western's Library https://www.lib.uwo.ca/.)

Course Website

Students are responsible for checking the course OWL site (https://westernu.brightspace.com/) regularly for news and updates. This is the primary method by which information and selected course material will be disseminated to all students in the class.

If students need assistance with the course OWL site, they can seek support on the OWL Brightspace Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800

Technical Requirements

Calculators:

You will require a cordless, non-programmable scientific calculator. No other electronic and/or wireless devices may be in your possession during quizzes, tests and exams except for this simple scientific calculator.

Computing and Software:

A solid understanding of statistical modelling using regression methodology is best achieved through the analysis of real data using computer software. We will be using R (a free statistical computing and graphics software environment) to analyze data using regression techniques in this course. R is freely available to be installed on your home/personal computer. The use of R will be emphasized in class examples and in some tutorials. Some helpful references related to R are listed above.

Homework:

A list of homework problems will be posted on the course website. This may be updated throughout the term. Students' homework solutions are not to be handed in. However, working on these problems regularly and diligently is essential to success in the course. In addition to the posted list of homework problems, you are strongly encouraged to attempt additional problems for extra practice!

Intellectual Property Statement

Course material developed by your instructor is the intellectual property of the instructor and is made available to students enrolled in this course for their personal use in this course. Sharing, posting or selling this material to third parties (i.e., to people outside of those in this course, or to companies, websites, organizations, associations, etc.) is considered an infringement of intellectual property rights.

5. Methods of Evaluation

University Accreditation Program – Canadian Institute of Actuaries (CIA)

Honours Specialization in Actuarial Science

If you graduate from Western with an HSP in Actuarial Science, this course will be one of the courses that you will take in your program that will allow you to be exempt from the preliminary exams of the Society of Actuaries (SOA). If your plan is to become a fully qualified actuary working in Canada, then all you would need to do is graduate from your HSP in actuarial science and you would then be eligible for the CIA Capstone Exam. Taking and passing this exam, along with completing two online modules and a practice education course, would make you eligible to become an ACIA (Associate of the Canadian Institute of Actuaries).

Major in Actuarial Science

If you graduate from Western with a major in Actuarial Science, the CIA accreditation program will not apply to you. If your plan is to become a fully qualified actuary, then you will need to continue to write and pass the preliminary exams of the SOA.

Please see the following link for full details:
https://www.cia-ica.ca/starting-your-journey/actuarial-education-in-canada/

In addition to the university's internal policies on conduct, including academic misconduct, candidates pursuing credits for writing professional examinations shall also be subject to the **Code of Conduct and Ethics for Candidates in the CIA Education System**. https://www.cia-ica.ca/publications/223159e/

Grading Scheme and Tentative Schedule for Assessments

The overall course grade will be calculated as listed below:

Assessment*	Tentative Number and Approximate Timing/Due Date	Weight
Quizzes	Quizzes will be held during the tutorials as follows: • Quiz 1: Sept. 23 • Quiz 2: Oct. 7 • Quiz 3: Oct. 21 • Quiz 4: Nov. 18 • Quiz 5: Dec. 2	Best 4 out of 5 (7.5% each) for a total weight of 30%
Term Test**	There will be one term test, held during class and tutorial on Monday, November 4 from 1:30 – 3:30 pm	20%
Final Exam**	3-hour, cumulative. To be held during the Exam Period and will be scheduled by the Registrar's Office.	50%
TOTAL		100%

*All assessments are closed book.

**Graduate students enrolled in SS9859A will be required to answer additional questions on the term test and the final exam.

General Information about Missed Coursework

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs* posted on the Academic Calendar: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult Accessible Education.

For procedures on how to submit Academic Consideration requests, see the information posted on the Office of the Registrar's webpage: https://registrar.uwo.ca/academics/academic_considerations/

All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course. However, the following assessments are excluded from this, and therefore always require formal supporting documentation:

- The final exam (Defined by policy)
- The midterm test (Designated by the instructor as the one assessment that always requires documentation when requesting Academic Consideration)

When a student *mistakenly* submits their one allowed Academic Consideration request **without supporting documentation** for the assessments listed above or those in the **Coursework with Assessment Flexibility** section below, the request cannot be recalled and reapplied. This privilege is forfeited.

Evaluation Scheme for Missed Assessments

- Any missed assessment without an approved academic consideration request will be assigned a grade of zero.
- The weight of a missed quiz that was missed due to an approved Academic Consideration request will be shifted to the final exam.
- The weight of a missed term test that was missed due to an approved Academic Consideration request will be shifted to the final exam.

When a student misses the Final Exam and their Academic Consideration has been granted, they will be allowed to write the Special Examination (the name given by the University to a makeup Final Exam). See the Academic Calendar for details (under Special Examinations), especially for those who miss multiple final exams within one examination period.

Essential Learning Requirements

Even when Academic Considerations are granted for missed coursework, the following are deemed essential to earn a passing grade:

- Before the final exam, students are required to have completed assessments whose weight totals at least 30% of their final grade. Students who do not meet this requirement will be assigned a grade of incomplete and may be given an opportunity to complete this requirement during the next offering of the course.

Coursework with Assessment Flexibility

By policy, instructors may deny Academic Consideration requests for the following assessments with built-in flexibility:

Flexible Completion

Quizzes. This course has 5 quizzes, and the 4 quizzes with the highest marks are counted towards your final grade. Should extenuating circumstances arise, students do not need to request Academic Consideration for the first missed quiz. Academic consideration requests will be denied for the first quiz. Academic Consideration requests may be granted when students miss more than 1 quiz, and these additional (2nd, 3rd…) missed quizzes will be reweighted to the final exam.

6. Additional Statements

Privacy: The names of student(s) may be divulged to other members of the class during class activities. Individuals who are concerned about such disclosures should contact the course instructor to identify whether there are any possible alternatives.

Checking Marked Work: In the event of a question regarding a mark or a final grade, students are responsible for retaining and presenting any graded materials that were returned to the student during the term. Students have one week from the date the material was returned in class to report any apparent error in the marking and appeal their grade. No marks will be changed after that time. The instructor reserves the right to remark the entire assessment (e.g., assignment, lab, quiz, test, project, exam, etc.).

Grades: Marks will not be disclosed or discussed by email or telephone. This includes final grades. Students who wish to discuss a grade on an assessment or their final grade in the course are welcome to do so during office hours or to contact the instructor to set up an appointment to meet.

Religious Accommodation: When conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible but not later than two weeks prior to the writing or the examination (or one week prior to the writing of the test). Please visit the Diversity Calendars posted on our university's EDID website for the recognized religious holidays: https://www.edi.uwo.ca.

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.

Academic Policies: The website for Registrar Services is https://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.

Technical Requirements: You will require a cordless, non-programmable scientific calculator. No other electronic and/or wireless devices may be in your possession during quizzes, tests and exams except for this simple scientific calculator.

Scholastic offences: These 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: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

Support Services:
Please visit the Science & Basic Medical Sciences Academic Advising 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 Learning Development and Success (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/.