SS3859A/SS9859A Regression
Course Outline – Fall 2025

1. Course Information

Lectures:	Mondays	1:30 – 2:30 pm	University Community Centre (UCC) 146
	Wednesdays	1:30 – 2:30 pm	Social Science Centre (SSC) 3022
	Fridays	1:30 – 2:30 pm	Social Science Centre (SSC) 3022
Tutorials:	Mondays	2:30 – 3:30 pm	University Community Centre (UCC) 146

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 prerequisites for this course or written special permission from the Department of Statistical and Actuarial Sciences to enroll in it, you may be removed from this course in accordance with university policy. This may be done after the add/drop deadline of the academic term, and the course will be marked as withdrawn (WDN) on your academic record. This decision may not be appealed.

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. These typically will be run in an open format with topics and structure varying from week-to-week. Possible tutorials include open help sessions, data modelling demonstrations, supplementary material, or review, etc. Tutorial time may be used to make up missed class time if necessary. Tutorial time may also be used for assessments such as quizzes/tests.

Important Dates (See https://www.westerncalendar.uwo.ca/SessionalDates.cfm for a complete list)

Sept. 4	Classes begin
Sept. 12	Last day to add a Fall/Winter 24-week course or a Fall 12-week course.
Sept. 15	Canada Life Day. (An event for Actuarial Science students.) No classes/tutorials.
Sept. 30	National Day for Truth and Reconciliation (observed at Western). No classes/ tutorials.
Oct. 13	Thanksgiving holiday. No classes/tutorials.
Nov. 3 – 9	Fall Reading Week (Monday to the following Sunday). No classes/tutorials.
Dec. 1	Last day to withdraw from a Fall 12-week course without academic penalty *(extended from Sunday, Nov. 30)*
Dec. 9	Last day of classes in the Fall term
Dec. 10	Study Day(s)
Dec. 11 – 22	December Examination period

Tentative Schedule

Week	Dates	Topic
1	Sept. 5	Course information; Overview of statistical modelling and regression
2	Sept. 8 – 12	Introduction to simple linear regression; Estimation techniques for regression model fitting (least-squares, maximum likelihood)
3	Sept. 15 – 19	Properties of estimators and sampling distributions (simple linear regression); F-test for regression; Hypothesis testing and confidence intervals for parameters
4	Sept. 22 – 26	Coefficient of determination; Confidence intervals for the conditional mean; Prediction intervals for new observations
5	Sept. 29 – Oct. 3	Indicator variables; Comparing models; Introduction to multiple regression
6	Oct. 6 – 10	Multiple linear regression, overview and estimation
7	Oct. 13 – 17	Model checking and diagnostics; Residuals, outliers, leverage and influence
8	Oct. 20 – 24	Extrapolation; Transformations and weighting
9	Oct. 27 – 31	Model building techniques/variable selection
10	Nov. 3 – 7	Reading week (no classes or tutorials)
11	Nov. 10 – 14	Estimator properties (multiple linear regression); Confidence/prediction intervals
12	Nov. 17 – 21	Sequential sum of squares and nested models; Standardized regression
13	Nov. 24 – 28	Multicollinearity; Ridge/LASSO; Time-series data regression; serial autocorrelation
14	Dec. 1 - 5	Intro to logistic regression; Smoothing (e.g., local regression/penalized splines)
15	Dec. 8 - 9	Summary and review

4. Course Materials

Required textbook

- Montgomery, D. C., Peck, E. A., & Vining, G. G. (2021). *Introduction to Linear Regression Analysis*, 6th Ed. John Wiley & Sons. (Cost $158.95; https://www.wiley.com/en-jp/Introduction+to+Linear+Regression+Analysis%2C+6th+Edition-p-9781119578727)
- Examples will primarily come from this edition. Furthermore, parts of the recommended homework will be assigned from this edition. However, second hand or older editions should be more than sufficient. Copies of this edition and older editions are also available through Western's Library https://www.lib.uwo.ca/)

Supplementary References[1]

Regression

- Faraway, J. J. (2002). *Practical regression and ANOVA using R.* (Cost: Freely available at: https://cran.r-project.org/doc/contrib/Faraway-PRA.pdf)
- Sheather, S. *A Modern Approach to Regression with R*. Springer. (Cost: Free e-versions of the first (2009) and second editions (2013) available to students through Western's Library https://www.lib.uwo.ca/.)

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.* (Cost: Freely available at https://cran.r-project.org/doc/manuals/R-intro.pdf)
- Wickham, H., & Grolemund, G. (2017). *R for Data Science*. (Cost: Free at https://r4ds.hadley.nz/)

Probability and Statistics (pre-requisite material)

- Devore, J.L. and Berk, K.N. (2012/2016). *Modern Mathematical Statistics with Applications,* 1st/2nd Ed. Springer. (Cost: E-versions available to students through Western's Library https://www.lib.uwo.ca/.)

[1]*Note, these are not required or optional. This is simply a list of other references related to regression, R software, and pre-requisite probability and statistics material provided as a courtesy for students looking for supplementary learning material.*

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

Grading Scheme and Tentative Schedule for Assessments

Assessment	Tentative Number and Approximate Timing/Due Date	Weight
Prerequisite Assessment	Closed book. A short assessment covering key prerequisite material will be held during the first tutorial session on Sept. 8.	2%
Assignments	There will be two assignments focusing on applied regression analysis using R and communication with due dates as follows: • Assignment 1: Oct. 17 • Assignment 2: Nov. 28 A "no late penalty period" of 2 days past the due date will apply to assignments.	8%
Quizzes	Closed book. Quizzes will be held during the following tutorials: • Quiz 1: Sept. 22 • Quiz 2: Oct. 6 • Quiz 3: Nov. 17	25% Best 2 out of 3
Term Test*	A closed book test will be held during class and tutorial time on • Monday, October 27 from 1:30 – 3:20 pm	25%
Final Exam*	A 3-hour, cumulative closed book exam is to be held during the Exam Period and will be scheduled by the Registrar's Office.	40%
TOTAL		100%

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

Generative AI

The use of generative AI is not permitted for any closed book assessments (e.g., quizzes, tests, exams). However, as an instructor I recognize the pervasive nature of generative AI and further recognize that its use can help support learning and the achievement of course learning outcomes. Consequently, you are permitted to use generative AI for any "open book" assessments (e.g., assignments). However, note that it is not the instructor's intention for the potential use of generative AI in any such assessments to replace or detract from your learning of key knowledge and skills. Consequently, authentic and alternative assessment techniques will be employed to support your learning and the achievement of learning outcomes. When necessary or applicable, specific instructions on the appropriate use of generative AI for a given learning activity or assessment will be provided. In such situations, students not comfortable with the use of generative AI are welcome to discuss their concerns and possible alternatives with the instructor. Finally, please note that if you choose to use generative AI for any learning activity or assessment, you are expected to do so ethically; you must fully disclose and describe what tool(s) were used, providing proper citations; and, you must ensure that all submitted work is in accordance with the student code of conduct and institutional policies related to academic integrity and scholastic offences because you will be accepting responsibility for its output if included in any submitted work.

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/

6. Student Absences

Academic consideration requests are *handled differently* for undergraduate and graduate students. If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures from the applicable subsection below.

- Undergraduate students should consult Section 6.1
- Graduate students should consult Section 6.2

Details regarding how missed assessments and late submissions will be handled are discussed in Section 6.3.

6.1 Undergraduate Student Absences

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 such requests 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 term 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.

6.2 Graduate Student Absences

Graduate students must provide valid documentation for medical-related absences or adequate supporting documentation for non-medical absences to the instructor as soon as possible and no later than 48 hours after the missed assessment. Documentation for medical illness must include the completion of a Western Student Medical Certificate (SMC) or, where that is not possible, equivalent documentation, by a health care practitioner. The SMC is available online here: https://uwo.ca/univsec/pdf/academic_policies/appeals/medical_certificate.pdf

6.3 Missed Assessments and Late Submissions

The material in this subsection is applicable to all students, both undergraduate and graduate.

Evaluation Scheme for Missed Assessments

Any missed assessment without approved academic consideration will receive a grade of zero.

For any assessments that are missed due to approved accommodation or academic consideration one of the following will occur: an extension to its due date will be given; or the weight will be reassigned within that given method of evaluation; or a make-up assessment will be offered; or the weight will be shifted to another grade component/components. The decision on how to proceed in such a situation will be on a case-by-case basis and is at the discretion of the instructor. For example:

- Missed prerequisite assessment: There is no make-up. Typically, the weight of a prerequisite assessment was missed due to approved academic consideration will be shifted to the exam.
- Missed assignment: Assignments have a no-late-penalty period. See "Coursework with Assessment Flexibility" material below for more details on how this applies to assignments.
- Missed quiz: There are no make-up quizzes. There is a flexibility component to quiz grading. See "Coursework with Assessment Flexibility" below for more details on how this applies to quizzes.

- There are no make-up term tests. Documentation is required for any academic consideration request for a missed term test. Typically, the weight of a term test that was missed due to an approved academic consideration request will be shifted to the final exam.

If a make-up assessment is missed, a grade of INC may be assigned, and the student may be required to complete the assessment the next time the course is offered.

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 and this must include at least one assignment. 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:

Deadline with a No-Late-Penalty Period

Assignments: Should extenuating circumstances arise, students do not need to request academic consideration if they are not able to submit an assignment on time; they are permitted to submit their assignment up to 48 hours past its due date. Should students submit their assessment beyond this no-late-penalty period, a penalty of 25% per day or portion thereof (including weekends and holidays) will apply. Submissions that are 4 or more days late past the no-late-penalty period will not be marked and will receive a grade of zero. Note that students will be given plenty of time (about 10 – 14 days) to complete an assignment and students are expected to work on each assignment during this period, rather than rushing to complete it shortly before it is due. Consequently, academic consideration requests may be granted only for extenuating circumstances that started well before an assignment's due date and lasted longer than the 48 hour no-late-penalty period, otherwise they may be denied.

Flexible Completion

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

7. Additional Statements

7.1 Instructor Policies

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 on an assessment or a final grade, students are responsible for retaining and presenting any graded materials that were returned to the student during the term. In addition, students have one week from the date the graded material was returned (either in-person or released electronically) 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.

7.2 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.

7.3 Academic 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.

7.4 General Academic Policies

The website for Registrar Services is https://www.registrar.uwo.ca/.

Use of @uwo.ca email: 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.

Requests for Relief (formally known as "appeals")
Policy on Request for Relief from Academic Decision:
https://uwo.ca/univsec//pdf/academic_policies/appeals/requests_for_relief_from_academic_decisions.pdf

Procedures on Request for Relief from Academic Decision (Undergraduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_requests_for_relief_procedure.pdf

Procedures on Request for Relief from Academic Decision (Graduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/graduate_requests_for_relief_procedure.pdf

7.5 Scholastic Offences

Policy on Scholastic Offences:
https://uwo.ca/univsec//pdf/academic_policies/appeals/scholastic_offences.pdf

Procedures on Scholastic Offences (Undergraduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_scholastic_offence_procedure.pdf

Procedures on Scholastic Offences (Graduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/graduate_scholastic_offence_procedure.pdf

Use of Electronic Devices During Assessments
In courses offered by the Faculty of Science, the possession of unauthorized electronic devices during any in-person assessment (such as tests, midterms, and final examinations) is strictly prohibited. This includes, but is not limited to: mobile phones, smart watches, smart glasses, and wireless earbuds or headphones.

Unless explicitly stated otherwise in advance by the instructor, the presence of any such device at your desk, on your person, or within reach during an assessment will be treated as a *scholastic offence*, even if the device is not in use.

Only devices expressly permitted by the instructor (e.g., non-programmable calculators) may be brought into the assessment room. It is your responsibility to review and comply with these expectations.

Use of Generative AI Tools
Unless otherwise stated, the use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Google Gemini, or similar platforms) is **not permitted** in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations.

Using such tools for content generation, code writing, problem solving, translation, or summarization—when not explicitly allowed—will be treated as a **scholastic offence**.

If the use of generative AI is permitted for a particular assessment, the conditions of use will be specified by the instructor in advance. If no such permission is granted, students must assume that use is prohibited. It is your responsibility to seek clarification before using any AI tools in academic work.

Turnitin
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).

7.6 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.

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