

SS 2858B Probability and Statistics II

Course Outline – Winter 2026

1. Course Information

Lectures:	Mon/Wed/Fri	2:30 – 3:30 pm	Health Sciences Building (HSB) 35
Tutorials:	Tues	3:30 – 4:30 pm	Western Science Centre (WSC) 55

This is an in-person course. You are expected to attend lectures and actively engage in learning the material that is presented. You are also expected to attend tutorials, the format of which may vary from week-to-week. Possible tutorials include open help sessions, problem solving sessions, data modelling/computing demonstrations, review, etc. Tutorials could be used to make up missed class time if necessary. Finally, please note that the quizzes will be held during tutorial times (see Section 5).

Prerequisite(s): A minimum mark of 60% in [Statistical Sciences 2857A/B](#).

Unless you have either the prerequisites for this course or written special permission from the Dept. of Statistical and Actuarial Sciences to enroll, 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 This may be done after the add/drop deadline of the academic term, and the course will be marked as withdrawn (WDN) on your academic record.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.

Antirequisite(s): All other courses in Introductory Statistics (except [Statistical Sciences 1023A/B](#) and [Data Science 1000A/B](#) or the former [Statistical Sciences 1024A/B](#)): [Biology 2244A/B](#), [Economics 2122A/B](#), [Economics 2222A/B](#), [Geography 2210A/B](#), [Health Sciences 3801A/B](#), [MOS 2242A/B](#), [Psychology 2811A/B](#) or the former Psychology 2810, [Psychology 2801F/G](#) or the former Psychology 2820E, [Psychology 2830A/B](#), [Psychology 2850A/B](#), [Psychology 2851A/B](#), [Social Work 2207A/B](#), [Sociology 2205A/B](#), [Statistical Sciences 2035](#), [Statistical Sciences 2141A/B](#), [Statistical Sciences 2143A/B](#), [Statistical Sciences 2244A/B](#).

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 you are 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: An introduction to the theory of statistics with strong links to data as well as its probabilistic underpinnings. Topics covered include estimation and hypothesis testing, sampling distributions, linear regression, experimental design, law of large numbers and central limit theorem.

Course-Level Learning Outcomes

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

- Explore, summarize and visualize both quantitative and qualitative data;
- Describe the difference between a mathematical, parametric model, and algorithmic models;
- Develop simple statistical models for real world phenomena using models based on common parametric probability distributions;
- Define the concepts of point and interval estimation and their role in statistical inference for parametric models;
- Explain what a statistic is and the difference between an estimate and an estimator;
- Describe and determine key properties of estimators and use these to evaluate an individual estimator and to compare different estimators;
- Use data to calibrate (or fit) a statistical model to describe the underlying population of interest using method of moments, maximum likelihood estimation, and least-squares estimation;
- Implement numerical methods (e.g., Newton-Raphson) to calculate an estimate when closed-form solutions are unavailable;
- State the Law of Large Numbers and explain why this justifies using sample means as estimators for population means;
- Explain the Central Limit Theorem, interpret its significance in statistical inference, and apply it—when appropriate—to approximate the sampling distribution of sample means and proportions;
- Quantify the uncertainty of estimates by calculating standard errors and confidence intervals;
- Calculate prediction intervals and explain the difference between a confidence interval for a parameter and a prediction interval for a new observation;
- Formulate hypotheses about a population and then use a fitted statistical model to test such hypotheses;
- Understand the difference between Type I and Type II error, the tradeoff between these that occurs when conducting hypothesis tests, and how to calculate power of a test in simple scenarios;
- Understand the need for a method for testing differences between different treatment levels and how to apply one-way analysis of variance;
- Explain correlation, the concept of conditional means, and describe the goal of simple linear regression in modelling the relationship between a response and a covariate (i.e., predictor);
- Derive, calculate and interpret least-squares estimates for a simple linear regression model;
- Conduct goodness of fit tests for categorical data;
- Use tools from R (a widely used statistical software package) to analyze data.

Important Dates*

Jan. 5	Classes resume
Feb. 14–22	Spring Reading Week (including Family Day, Saturday to Sunday on the following week)
Mar. 30	Last day to withdraw from a Winter 12-week course without academic penalty
Apr. 3	Good Friday (no classes)
Apr. 9	Last day of classes in the Winter term
Apr. 10-11	Study Days
Apr. 12-30	April examination period

*See <https://www.westerncalendar.uwo.ca/SessionalDates.cfm> for a complete list of sessional dates.

Tentative List of Topics

Overview

- Populations, parameters, samples and data
- Data types (quantitative, qualitative/categorical – ordinal vs nominal);
- Exploratory data analysis including numerical descriptive statistics and visualization methods
- Models in general; Data modelling methods (parametric vs algorithmic); Calibration
- Statistics; Estimates; Estimators; Sampling distributions

Point Estimation

- Parametric models; Estimation methods (maximum likelihood; method of moments)

Properties of Estimators

- Mean; Variance; Bias/Unbiased; Mean squared error;
- Sampling distributions; Law of Large Numbers; Central Limit Theorem

Interval Estimation

- Standard error; Confidence intervals for parameters; Prediction intervals for new observations
- Resampling/bootstrap methods

Hypothesis Testing

- Hypotheses: simple; composite; null and alternative hypotheses (single and two-sided)
- Significance level of the test; Critical/rejection region; P-values and strength of evidence
- Type I and Type II errors; Power
- Tests for means and proportions for single sample, two-sample and paired data;
- Permutation tests

Categorical Data Analysis

- Goodness of fit tests; Contingency tables

Introduction to Analysis of Variance

- Factor variables; One way ANOVA;

Introduction to Regression

- Correlation; Conditional mean; Least-squares estimation; Simple linear regression

The above material corresponds to most of the material from Chapters 6 – 13 of the required textbook listed below.

4. Course Materials

Required Textbook(s)

Devore, J. L., & Berk, K. N. (2012). *Modern Mathematical Statistics with Applications* (2nd ed.). Springer, New York.

- Examples and recommended homework will primarily come from this edition. However, any other edition (either new or second hand) should also be sufficient.
- Cost: Electronic version available for free to Western students through the library here: <https://books.scholarsportal.info/en/read?id=/ebooks/ebooks2/springer/2012-05-29/1/9781461403913> and <https://link.springer.com/book/10.1007/978-1-4614-0391-3>

Course Website

Students are responsible for checking the course OWL site (<https://westernu.brightspace.com/>) regularly for news and updates. Besides what is presented and discussed during lectures and tutorials, 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

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.

Technical Requirements

Calculators: You will require a cordless, non-programmable scientific calculator. No other electronic and/or wireless devices (e.g., smart phones/watches/glasses, laptops, tablets, etc.) may be in your possession during quizzes, tests and exams except for this simple scientific calculator.

Homework

A list of suggested homework problems will be posted on the course website and 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.

This list represents the minimum number of practice problems that should be attempted when studying for this course. It is strongly recommended that students try other problems, especially if one is having difficulty with a specific topic.

5. Methods of Evaluation

Grading Scheme and Tentative Schedule for Assessments

Assessment*	Tentative Number and Approximate Timing/Due Date	Weight
Quizzes	There will be five, 30-minute-long quizzes, held during the following tutorial sessions: • Quiz 1: Tuesday, January 20 • Quiz 2: Tuesday, February 3 • Quiz 3: Tuesday, February 24 • Quiz 4: Tuesday, March 24 • Quiz 5: Tuesday, April 7	30% (Best 4 out of 5)
Midterm Test	There will be one, 50-minute long midterm test, to be held in tutorial on Tuesday, March 10.	20%
Final Exam	There will be a 3-hour long, cumulative exam, held during the Exam Period and scheduled by the Registrar's Office.	50%
TOTAL		100%
*All assessments are closed book.		

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/>

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 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 approved academic consideration will be assigned 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. Typical situations and how they will be handled are described below:

- There are no make-up quizzes. The weight of a quiz that was missed due to an approved Academic Consideration request will typically be shifted to the final exam.
- There are no make-up tests. The weight of a term/midterm test that was missed due to an approved Academic Consideration request will typically be shifted to the final exam.
- If a make-up assessment is missed, a grade of 0 or INC may be assigned. If the latter occurs, 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. (In other words, students must have written at least four quizzes, or at least two quizzes and the term test.) 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 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 the weight associated with these additional (2nd, 3rd...) missed quizzes will typically be reweighted to the final exam.

6. Additional Statements

6.1 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.

6.2 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>.

6.3 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](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Accommodation_disabilities.pdf).

6.4 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

6.5 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>).

6.6 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/>.