

Intermediate Probability (SS 3657A)

Course Outline

1. Course Information

Course Information

Term: Fall 2025

Lectures: Monday, Wednesday, Friday 11:30 – 12:30 and Location: FNB-1250

Tutorials: Wednesday 5:30-6:30 and Location: SSC-2028

List of Prerequisites

A minimum mark of 60% in Statistical Sciences 2858A/B and in Statistical Sciences 2503A/B or Calculus 2503A/B.

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special permission from the Department of Statistical and Actuarial Sciences to enroll in it, you may be removed and withdrawn from this course in accordance with university policy. This may be done after the add/drop deadline of the academic term, and the course will be marked as withdrawn (WDN) on your academic record.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

Instructors	Email	Office	Phone	Office Hours
Dr. Parisa Hesari	pmokhta@uwo.ca			Wednesday 6:30-7:30

Students must use their Western (@uwo.ca) email addresses when contacting their instructors.

3. Course Syllabus, Schedule, Delivery Mode

Course Description

A continuation of the study of multivariate probability and stochastic processes. This course builds on the background developed in the second-year courses and focuses on the more advanced aspects of multivariate probability, namely transformations where the domain of random variables must be carefully considered.

Course Objectives

This course aims to extend students' understanding of probability theory to multivariate settings and stochastic processes. Students will learn how to analyze the joint behavior of multiple random variables, perform transformations with careful attention to domains, and compute key quantities such as expectations and covariances. The course also introduces foundational stochastic processes.

Course-level learning outcomes

By the end of the course, students will be able to explain and apply the concepts of joint, marginal, and conditional distributions, independence, and correlation. They will be able to carry out transformations of random variables, compute expectations and variances in multivariate contexts, and apply conditional expectation in prediction.

Classes begin: September 4, 2025

Fall Reading Week: November 3 – 9, 2025

Classes end: December 9, 2025

Exam period: December 11 – 22, 2025

Week	Dates	Lectures & Tutorials	Quizzes & Assignments
1	Sept 05	Course outline & Overview	
2	Sept 08-12	Combinatorial Analysis & Probability Basics <ul style="list-style-type: none">Counting principles: permutations, combinations, multinomial coefficients.Sample spaces and events, axioms of probability.	
3	Sept 15-19	Conditional Probability and Independence <ul style="list-style-type: none">Conditional probabilities, Bayes' formula.Independent events and random variables.	Sept 15, Quiz #1 Assignment #1 Due Sept 25, 11:59 pm.

4	Sept 22-26	Discrete Random Variables – Part I <ul style="list-style-type: none"> • Definition and properties of discrete random variables. • Expectation and variance for discrete RVs. • 	Sept 24, Quiz #2
5	Sept 29- Oct 01	Discrete Random Variables – Part II <ul style="list-style-type: none"> • Poisson, geometric, negative binomial, hypergeometric, and other discrete distributions • Expectation and variance for discrete RVs • 	Assignment #2 Due October 10, 11:59 pm.
6	Oct 06-10	Continuous Random Variables – Part I <ul style="list-style-type: none"> • Introduction to continuous RVs: uniform, normal, exponential • Expectation and variance for continuous RVs • Tutorial: Practice problems on PDF, CDF, and expectations 	<ul style="list-style-type: none"> • Oct 06, Quiz #3
7	Oct 15-17	Continuous Random Variables – Part II <ul style="list-style-type: none"> • Gamma, Weibull, Beta, Pareto distributions • Distribution of a function of a random variable • Tutorial: Exercises on transformations and distributions 	<ul style="list-style-type: none"> • Assignment #3 Due Oct 19, 11:59 pm.
8	Oct 20-24	Jointly Distributed Random Variables – Part I <ul style="list-style-type: none"> • Joint distributions, marginal distributions • Independence of random variables • Tutorial: Problems on joint PMFs and PDFs 	Sept 22, Mid-term exam
9	Oct 27-31, Mon	Jointly Distributed Random Variables – Part II <ul style="list-style-type: none"> • Transformations: linear and nonlinear • Jacobian method for change of variables 	<ul style="list-style-type: none"> • Oct 27, Quiz #4 • Assignment #4 Due Nov 10, 11:59 pm.

		<ul style="list-style-type: none"> Joint distributions of functions of RVs Tutorial: Exercises on transformations of RVs 	
10	Nov 3- 9		Reading Week
11	Nov 10-14	<p>Expectation and Moment-Generating Functions</p> <ul style="list-style-type: none"> Expectation of sums and functions of RVs Covariance and correlation Conditional expectation and prediction Moment-generating functions Tutorial: Practice problems on expectations and MGFs 	
12	Nov 17-21	<p>Expectation and Moment-Generating Functions (Recap)& Multivariate Normal Distribution</p> <ul style="list-style-type: none"> Properties of multivariate normal Linear transformations, marginal and conditional distributions 	Nov 24, Quiz #5
13	Nov 24-28	<ol style="list-style-type: none"> Multivariate Normal Distribution (Recap) <ul style="list-style-type: none"> Applications Limit Theorems, <ul style="list-style-type: none"> Law of Large Numbers, Central Limit Theorem Applications and approximation methods 	<p>Assignment #5 Due Dec 03, 11:59 pm.</p>
14	Dec 01-05, Mon	<p>Stochastic processes</p> <ul style="list-style-type: none"> Introduction to Stochastic Processes Definition and classification of stochastic processes. Examples: Bernoulli processes, Poisson processes, and simple counting processes. 	Dec 01, Quiz #6
15	Dec 08	Review	

4. Course Materials

The required textbook for this course is:
Rice, John A. *Mathematical Statistics and Data Analysis*, 3th Edition

Students are required to purchase this edition. The current price can be found on the following website at [here](#).

Software Requirements

To fully participate in this course, students are required to install the following software before the second class (available for free). Note: R must be installed before RStudio, as RStudio runs on top of R.

Download R from: <https://cran.r-project.org>

Download RStudio from: <https://posit.co/download/rstudio-desktop>

Note: Throughout the course, some examples and demonstrations will be provided using the statistical software R to help illustrate key concepts. However, prior knowledge of R is not required, and students are not expected to use R in assignments, quizzes, or exams. These examples are intended to support understanding and are entirely optional for student engagement.

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 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.

5. Methods of Evaluation

Grading Scheme and Assessment Dates

The overall course grade will be calculated as listed below:

Assignments (#4)	20%
Quizzes (#6)	12%
Participation	8%
Midterm exam	20%
Final exam	40%

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, please 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:

- Examinations scheduled during official examination periods (Defined by policy)
- Midterm (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

Evaluation Scheme for Missed Assessments

This section outlines how missed assessments will be handled, including provisions for extensions, make-up opportunities, and reweighting.

If extensions are granted for any assessment, a final submission deadline will be set, after which no submissions will be accepted, even with Academic Consideration. Examples of such cut-off dates include when assignment solutions are posted or when peer-reviewed activities are completed. This cut-off is particularly important for assessments where Academic Consideration may be granted without documentation, and no automatic end date applies. After this deadline, missed assessments may be reweighted to another component (e.g., the final exam).

All rules for missed assessments are designed to ensure that the essential learning requirements of the course are still fulfilled.

Students who miss the **Midterm Exam** may be eligible to have the midterm weight added to their final exam if they provide valid documentation.

If a student misses the **Final Exam** and Academic Consideration is granted, they will be permitted to write the **Special Examination** (the University's official make-up final exam). For details, especially for students missing multiple final exams, refer to the Western University Academic Calendar under [Special Examinations](#).

Essential Learning Requirements

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

Any course-specific conditions related to essential learning objectives that are required to pass the course must be outlined. Typical examples include:

- a minimum number of completed labs or a minimum grade on the laboratory component to ensure that students demonstrate sufficient mastery of those technical skills to progress,
- a passing grade on essays or lab reports in a course designated as an “essay course” (i.e., with a suffix of E, F, G, or Z) to satisfy the Senate requirement that students must demonstrate “some minimal competence in essay writing” in order to pass the course,
- a minimum grade on the final exam (or a minimum average on the midterm test(s) and final exam) to ensure that students demonstrate sufficient mastery of the learning outcomes, and
- minimum participation in a seminar course or a group project.

In such cases, the consequences of not meeting the requirement (e.g., a grade of 45) should be specified. Note that students should not be penalized for failing to meet a requirement where Academic Considerations are granted. For example, a student who misses too many labs due to illness to receive course credit should be given an opportunity to complete those labs after they recover. However, for logistical reasons, it is permissible for that opportunity to be with the next offering of the course, in which case the student will receive a grade of Incomplete (INC) and their maximum course load may be reduced during the term in which they complete their course requirements.

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 includes six quizzes that count toward your final grade. Should extenuating circumstances arise, students do not need to request Academic Consideration for the first two missed quizzes. Academic consideration requests will be denied for the first two missed quizzes. Academic Consideration requests may be granted when students miss more than two quizzes, and these additional missed quizzes will be reweighted to the final exam.

Deadline with a No-Late-Penalty Period

Assignments. Students are expected to submit each of the assignments by the deadline listed. Should extenuating circumstances arise, students do not need to request Academic Consideration and they are permitted to submit their assignment up to 72 hours past the deadline without a late penalty. Should students submit their assessment beyond 72 hours past the deadline, a late penalty of 10% per day will be applied. Academic Consideration requests may be granted only for extenuating circumstances that started before the deadline and lasted longer than the No-Late-Penalty Period 72 hours.

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, quizzes tests, and final/midterm examinations.

6. Additional Statements

6.1 Religious Accommodation

When conflicts arise 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 of 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>

6.2 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.

6.3 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 email address. It is the responsibility of the account holder to ensure that emails received from the University at their official university address are 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

6.4 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

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.

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>).

Tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide **personal information** (including some biometric data) and the session will be **recorded**. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western's Remote Proctoring website at:

<https://remoteproctoring.uwo.ca>.

6.5 Support Services

Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, requests for relief, 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 (GBSV) and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced GBSV (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. If you have any questions regarding accommodations, you may also wish to contact Accessible Education at

http://academicssupport.uwo.ca/accessible_education/index.html

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/>.

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/>