IVEY PhD Business School
WESTERN UNIVERSITY · CANADA

Course Syllabus Fall 2025

Last Updated: September 12, 2025

MULTIVARIATE ANALYSIS

BUSINESS 9702

Thursdays 09:00 am - 12:00 pm

Professor: Mustafa Hayri Tongarlak
Office: 4366
E-mail: mtongarlak@ivey.ca

Assistant: Vanessa Sage
Email: vsage@ivey.ca

COURSE DESCRIPTION

This course introduces modern statistical methods for empirical research in business and related fields, balancing theoretical foundations with applied data analysis. Core topics include statistical inference, estimation, hypothesis testing, and regression modeling. Emphasis is placed on linear and nonlinear regression, ANOVA, and extensions such as regularization, resampling methods, and classification models. Students will also gain exposure to unsupervised learning techniques, including clustering and principal components analysis, as well as tree-based methods for prediction and interpretation. A central component of the course is the application of these methods to real-world datasets, with hands-on implementation in R.

COURSE OBJECTIVES

By the end of this course, students will be able to:

Develop a rigorous foundation in modern statistical inference and regression modeling for empirical research.

Apply advanced statistical methods (including regression extensions, resampling techniques, and classification models) to realistic datasets.

Understand and evaluate model assumptions, diagnostics, and limitations to ensure robust and credible research findings.

Gain proficiency in R for implementing statistical analyses, managing data, and producing reproducible results.

Strengthen research skills by integrating statistical methods into their own dissertation projects and future scholarly work.

MATERIALS

An Introduction to Statistical Learning with Applications in R, 2e (2023) by G. James, D. Witten, T. Hastie and R. Tibshirani - Ebook and Resources.

Regression Analysis by Example using R, 6e (2024) by S. Chatterjee and AS Hadi - Library and Ebook (4e)

Data Mining for Business Analytics: Concepts, Techniques, and Applications in R by Shmueli, G., Bruce, P. C., Yahav, I., Patel, N. R., Lichtendahl, K. C. (2018). Ebook through Library

EVALUATION

Weekly Labs (20 points)

Ten weekly labs (2 points each) are due by midnight on Sundays (except before sessions 11 and 12). Labs cannot be submitted late as Datacamp archives past assignments.

Individual/Group Assignments (30 points)

There will be three assignments (10 points each). Group discussion of individual assignments is permitted, but sharing complete solutions or software code is prohibited. If you worked with classmates on the assignment, please list their names at the top of your assignment.

Submissions are due by noon on Mondays. Late submissions will be accepted by 9 am on Thursday for a 2-point penalty.

Student Lectures (20 points)

Each student will give two presentations during the semester. Each week, a pair of students will lead the class by presenting key statistical concepts, selecting a simple open-source dataset, and demonstrating its application. Preparation should include dividing tasks, focusing on 2–3 central ideas, and creating clear, minimal slides with essential analysis and visualizations relevant to the week's topic. The session will consist of a 45-minute lecture followed by a 45-minute dataset application and class discussion. All students are expected to review materials in advance and participate actively. Evaluation will be based on lecture content (40%), dataset application (40%), and engagement in discussion (20%), with optional problem sets and instructor guidance available.

Class Contribution (10 points)

Your class contribution grade will be based on a daily performance assessment. Both the quantity and quality of your class contribution will be assessed. No credit will be given for missed classes. although you might be asked to provide evidence of your preparation in writing.

Remember, the main objective of your contribution is not evaluation but learning and helping your colleagues to learn.

Final project/exam (20 points)

The final project will be assigned in mid-November. It is exclusively an individual effort and must be completed as such. It is due Thursday, December 4, 2025.

Use of Generative Artificial Intelligence (AI)

The use of generative artificial intelligence (AI) tools/software/apps is **permitted in specific situations**. Students may use AI tools (e.g., for coding assistance in R, data visualization support, or refining the clarity of written work) provided that their use is disclosed and does not substitute for the student's own critical thinking, statistical reasoning, or original analysis. All substantive analysis, interpretation of results, and presentation of findings must be the student's own work. AI tools may **not** be used to generate full assignments, presentations, or analyses. Improper or undisclosed use of AI tools will be considered a breach of academic integrity.

COURSE TIMELINE AND FORMAT

Session	Topics
1	Descriptive Statistics
2	Simple Linear Regression Basics
3	Multiple Linear Regression Basics
4	Variable Selection in Regression, Transformation of Variables
5	Interactions, Nonlinearity and Multicollinearity in Regression
6	Ridge and Lasso Regression
7	Unsupervised Learning: Clustering
8	Principal Components Analysis
9	Hypothesis Testing with k=2 groups (k > 3 groups), ANOVA
10	Resampling Methods: Cross-Validation and Bootstrap
11	Logistic Regression and Classification
12	Tree-Based Methods

ATTENDANCE

On-time attendance in all sessions is mandatory. If absenteeism has reached 25 percent (i.e., more than 9 hours), your absences will be reported to the Dean's Designate, the PhD Program Director. You may not be eligible to submit the final project. This UWO policy is outlined at:
http://www.uwo.ca/univsec/pdf/academic_policies/exam/attendance.pdf

See also Western's Policy on Accommodation for Medical Illness at:
www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

In the event of an illness requiring medical documentation, please see the PhD Program office for specific instructions. Note that medical documentation must meet Western's requirements and be submitted to the PhD Program office, not the course instructor. Any non-medical absences from assignments, reports, and examinations must be approved by the PhD Program office and accommodation for such absences will only be granted under extenuating circumstances.

Notice of Absence
If you are unable to attend class, please email the professor in advance. Submitting assignments on time remains your responsibility.

ENROLLMENT RESTRICTIONS

Enrollment in this course is restricted to graduate students in the Ivey PhD Program and any student who has obtained special permission to enroll in this course from the course instructor and the Graduate Chair (or equivalent) from the student's home program.

ACADEMIC OFFENCES: PLAGIARISM AND ACADEMIC INTEGRITY

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at
https://grad.uwo.ca/administration/regulations/13.html

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).

GENDER-BASED SEXUAL VIOLENCE SUPPORT

Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who is going through or has gone through these traumatic events. If you are experiencing or have experienced GBSV (either recently or in the past), you will find information about support services for survivors, including emergency contacts at the following website: 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.

SUPPORT SERVICES: HEALTH AND WELLNESS

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several on campus health-related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. See https://www.uwo.ca/health.

Students who are in emotional/mental distress should refer to Health and Wellness at Western University https://www.uwo.ca/health/psych/index.html for a complete list of options about how to obtain help. Additionally, students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director or program coordinator.

ACCESSIBLE EDUCATION WESTERN (AEW)

Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program.

Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW), a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.