Carleton University

ECON 4708/ECON 5708: Economic Data Science - Analytics

Fall 2025

Professor Thomas Russell

General Information

The Instructor

Instructor: Thomas Russell

Email: thomas.russell3@carleton.ca

Office Location: Loeb Building B846

Office Hours: Tuesday 12:00 pm - 2:00 pm

Course Delivery

Course Delivery: In person only

Lectures: Tuesday 2:35 pm - 5:25 pm. See Carleton Central for the class location.

TA: N/A

Brightspace Course Webpage: https://brightspace.carleton.ca/d2l/home/389417

Course Description: An introduction to methods of statistical and machine learning analytics for economic analysis. Tools relevant for both small and large data sets will be covered. Topics may include approaches to classification, dimension reduction strategies, and prediction models and tools.

Learning Outcomes: The goal of this course is to introduce students to some of the most popular machine learning algorithms, and to demonstrate "off-the-shelf" applications of these algorithms to economic problems. The course assumes that students have sufficient background in statistics, probability theory, and multivariate linear regression. The course will focus primarily on supervised machine learning algorithms,

and may cover linear models, LASSO and ridge regression, logistic regression, nonparametric regression, decisions trees and random forests, support vector machines, bayesian methods, and neural networks. The course will also introduce students to programming in R, and will expose students to a variety of datasets from economics that are amenable to analysis using machine learning methods. No prior programming experience is required.

Course Preclusions: None.

Course Prerequisites: For ECON 4708, ECON 2708 with a grade of C+ or higher; and ECON 3210 (or equivalent) with a grade of C+ or higher. ECON 4706 is highly recommended. For ECON 5708, by permission of the department.

Course Calendar

Table 1 displays a list of important dates. The evaluation dates below are subject to change.

Dates	Event
September 9	First Class.
September 23	Assignment 1 posted.
October 7	Assignment 1 due in class. Assignment 1 quiz held in class.
October 20 - 24	Fall break, no classes.
October 28	Midterm exam (during class).
November 11	Assignment 2 posted.
November 25	Assignment 2 due in class. Assignment 2 quiz held in class.
December 2	Last class.
December 8 - 20	Final exam period.

Table 1: Important dates for ECON 4708/5708.

The tentative course outline is displayed in Table 2. Depending on the pace of the lectures, this course outline may be subject to modification.

Programming Requirements

Students will be required to use R for the assignments. Programming in R will be taught during lecture. R is a free and open-source programming language and environment used for statistical computing. Next to Python, it is one of the most in-demand languages for data science. Most of the programming in class will be done using either Jupyter notebooks or RStudio. Instructions on how to install R, RStudio and Jupyter notebooks will be posted on the course website before the first lecture. These programs should be installed before the first class.

Topic #	Lecture Dates	Topic	Readings
1	September 9, 2025	Introduction to Data Science, Intro to R	**(ISLR2)**: Ch. 1 & 2
2	September 16, 2025 September 23, 2025	Linear Regression, Shrinkage, and Model Selection	**(ISLR2)**: Ch. 3, 5 & 6
3	September 30, 2025	Nonlinear Extensions and Nonparametric Regression	**(ISLR2)**: Ch. 7.
4	October 7, 2025 October 14, 2025	Logistic Regression, Decision Trees, and Random Forests	**(ISLR2)**: Ch. 4 & 8
—	October 20 - 24, 2025	Fall Break: No Classes	
—	October 28, 2025	Midterm Exam (in class)	
5	November 4, 2025 November 11, 2025	Support Vector Machines	**(ISLR2)**: Ch. 9
5	November 18, 2025 November 25, 2025	Bayesian Methods	**(PRML)** Ch. 3.3 **(GPML)** Ch. 2
6	December 2, 2025	Intro to Neural Networks and Deep Learning	**(ISLR2)**: Ch. 10

Table 2: A tentative course outline for ECON 4708/5708.

Textbooks and Reading Materials

Students are not required to purchase textbooks or other learning materials for this course. However, there are a few references that students may find helpful. The main references are:

- **(ISLR2)** James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). An Introduction to Statistical Learning with Applications to R, *Second Edition*. Springer New York.
- **(PRML)** Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer Science and Business Media.
- **(GPML)** Williams, C. K., & Rasmussen, C. E. (2006). Gaussian processes for machine learning (Vol. 2, No. 3, p. 4). Cambridge, MA: MIT press.

The lecture material will also draw from the following sources:

- Abadie, A., & Kasy, M. (2019). Choosing Among Regularized Estimators in Empirical Economics: The Risk of Machine Learning. The Review of Economics and Statistics, 101(5), 743–762. https://doi.org/10.1162/rest_a_00812
- Athey, S. (2017). Beyond prediction: Using big data for policy problems. Science, 355(6324), 483–485. https://doi.org/10.1126/science.aal4321

- Athey, S. (2019). The Impact of Machine Learning on Economics. In The economics of artificial intelligence (pp. 507-552). University of Chicago Press. nber.org/system/files/chapters/c14009/c14009.pdf
- Hastie, T., Tibshirani, R., & Friedman, J. (2009). The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Springer Science & Business Media.
- Mohri, M., Rostamizadeh, A., & Talwalkar, A. (2018). Foundations of machine learning. MIT press.
- Mullainathan, S., & Spiess, J. (2017). Machine Learning: An Applied Econometric Approach. Journal of Economic Perspectives, 31(2), 87–106. https://doi.org/10.1257/jep.31.2.87
- Shalev-Shwartz, S., & Ben-David, S. (2014). Understanding machine learning: From theory to algorithms. Cambridge university press.
- Shmueli, G. (2010). To Explain or to Predict? Statistical Science, 25(3), 289–310. https://doi.org/10.1214/10-STS330
- Varian, H. R. (2014). Big Data: New Tricks for Econometrics. Journal of Economic Perspectives, 28(2), 3–28. https://doi.org/10.1257/jep.28.2.3

Evaluation

- Assignment 1 — 10%. To be posted on the course website on September 23, 2025. Due October 7, 2025, at 11:59 pm EST. To be submitted via the course website.
- Assignment 1 Quiz — 10%. To be held at the beginning of class on October 7, 2025.
- Midterm — 25%. The midterm will take place in class on October 28, 2025.
- Assignment 2 — 10%. To be posted on the course website on November 11, 2025. Due November 25, 2025, at 11:59 pm EST. To be submitted via the course website.
- Assignment 2 Quiz — 10%. To be held at the beginning of class on November 25, 2025.
- Final Exam— 35%. The final exam will be administered during the exam period, sometime between December 8 - 20, 2025. The final exam will be scheduled later in the term and more details will be released at that time.

Assignments and Assignment Quizzes

Students can work in groups of up to three individuals. Only one assignment per group needs to be submitted – list all groups members on your assignments. Assignments will require students to apply programming skills learned in class to a mix of theoretical and applied questions. All assignments will be submitted in class. Students may be required to submit both a written portion of the assignment (containing any mathematical derivations or explanations required to answer the assignment questions), as well as labelled R code used to answer any of the programming-based questions. Assignment marks may be deducted if any supporting code is not clearly labelled and/or explained. **Late assignments will be penalized 1 mark for each minute they are late, without exception.** For instance, an assignment that is submitted 5 minutes late will receive a 5 mark deduction from the total assignment score.

Students are free to use generative artificial intelligence (AI) tools (e.g. ChatGPT, Google Gemini, Claude, etc.) to assist with answering assignment questions. Re-use of the same piece of work previously submitted for credit in another course is prohibited.

Students registered in ECON 5708 will be required to answer additional assignment questions relative to students registered in ECON 4708.

On the day the assignments are due, there will be a quiz administered at the beginning of class. The quiz will require short answers only, and the quiz questions will be closely related to the assignment questions. The purpose of the quiz is to ensure all students have understood the key takeaways from the assignments. **There will not be a make up quiz for those who miss a quiz.** Those unable to complete a quiz for a valid reason will have the weight of the quiz shifted to the final exam.

Midterm Exam

The midterm will be administered in class on October 28, 2025, and will cover lecture material up to and including the lecture on October 14, 2025.

There will not be a make up exam for those who miss a midterm. Those unable to complete the midterm for a valid reason will have the weight of the midterm shifted to the final exam, resulting in a final exam worth 60%. Students who expect to be absent from the midterm for a valid reason should email the instructor as soon as possible. However, documentation may be required. The instructor reserves the right to request a Self-Declaration form or PMC letter of accommodation depending on the length of incapacitation. The documentation provided by students for missed or incomplete midterms will be subject to verification by the instructor. Submitting a forged note is regarded as a serious academic offense. Students who miss

the midterm exam and fail to provide sufficient documentation will receive a score of zero, without exception.

Students registered in ECON 5708 will be required to answer additional midterm exam questions relative to students registered in ECON 4708.

Final Exam

The final exam will be administered in-person and will be scheduled by the University during the final exam period from December 8 - 20, 2025. The final exam will cover lecture material up to and including the final lecture on December 2, 2025. The exam will be scheduled later in the term, and relevant details for the final exam will be announced at that time.

Students absent from the final exam should email the instructor as soon as possible. However, documentation may be required. The instructor reserves the right to request a Self-Declaration form or PMC letter of accommodation depending on the length of incapacitation. The documentation provided by students for missed or incomplete final exams will be subject to verification by the instructor. Submitting a forged note is regarded as a serious academic offense. Students who miss the final exam and fail to provide sufficient documentation will receive a score of zero, without exception.

Students are not to make travel plans during the exam period as that is not a valid reason for missing a final exam.

Students registered in ECON 5708 will be required to answer additional final exam questions relative to students registered in ECON 4708.

Satisfactory Performance Criteria

Students must fulfill all of the course requirements, including the final exam, in order to achieve a passing grade.

Deferred Final Exam

Students who do not write the final examination because of illness or other circumstances beyond their control may apply to write a deferred final examination by contacting the Registrar's Office no later than three working days after the original final examination was scheduled. In the event that a student writes a deferred examination, the deferred examination will carry the same weight as the final examination in determining the course grade. Any deferred examination will not be identical to the original final examination.

E-proctoring

E-proctoring will not be used for evaluations in this course.

Additional Information

Email Communication

Communication outside of class, tutorials and office hours will be done through email. For security purposes, please communicate only using your carleton.ca email address. Please include the course name "ECON 4708" or "ECON 5708" in the subject line of your email. **You can expect to receive a response to your email within 48 hours.** However, communication outside of class hours should occur only in exceptional cases; in particular, email is not the appropriate medium to ask questions about course material. Students who request clarification on course material through email will be directed to ask their question during class, tutorial or office hours.

Course Standing

Standing in a course is determined by the course instructor subject to the approval of the Faculty Dean. This means that grades submitted by the instructor may be subject to revision. No grades are final until they have been approved by the Dean. Application to write a deferred final examination must be made at the Registrars Office.

Copyright of Course Materials

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Plagiarism, Resources and Mental Health, Academic Accommodations

You are responsible for reading and knowing the information about plagiarism, Carleton University resources, and academic accommodations found here.