

APPLIED ECONOMETRICS II  
ECONOMICS EC3389B-001  
Department of Economics  
Western University

**General Information:**

**January 2022**

- Instructor:** Charles J. Saunders  
**Office:** 4078 SSC  
**Phone:** 519-661-2111 ext. 85410  
**E-mail:** csaund9@uwo.ca  
**Office hours:** Students must can request a meeting by email, to the professor. Time and date of a meeting will be determined via email. Students may request a Zoom meeting, or in-person (University and health guidelines permitting).
- Delivery mode:** Course content will be a combination of in-person and online delivery.
- Lectures will be delivered in-person (unless University and health and safety guidelines require online synchronous).
  - Laboratories will be delivered online via Zoom and synchronous.
- Meeting time(s):** Lectures: Monday 12:30 pm to 1:30 pm (in-person)  
Laboratories: Thursday 12:30 pm to 2:30 pm (online - Zoom)
- Classroom:** TC 342
- Extra Information:** *One hour lecture, two hour laboratory, 0.5 course. Students must have access to their own laptop/computer with R or R Studio installed (freeware), or a computer in one of the Campus computer labs*
- Course website:** <https://owl.uwo.ca/portal>
- Undergraduate inquiries:** 519-661-3507 or SSC Room 4075 or [econugrd@uwo.ca](mailto:econugrd@uwo.ca)

**Registration:**

You are responsible for ensuring you are registered in the correct courses. If you are not registered in this course, the Department will not release any of your marks until your registration is corrected. You may check your timetable by using the Login on the Student Services website at <https://student.uwo.ca>. If you notice a problem, please contact your home Faculty Academic Counsellor immediately.

**Prerequisite Note:**

The prerequisite(s) for this course is (are) **Economics 2223A/B**  
The antirequisite(s) for this course is (are) **Data Science 3000A/B, Computer Science 4414A/B, Statistical Sciences 3850B, and Software Engineering 4460A**

*(The prerequisites and antirequisites for your course can be found in the Western Calendar at: <http://westerncalendar.uwo.ca/Courses.cfm?Subject=ECONOMIC&SelectedCalendar=Live&ArchiveID>)*

You are responsible for ensuring that you have successfully completed all course prerequisites, and that you have not taken any antirequisite courses. Lack of prerequisites may not be used as a basis for appeal. If you are found to be ineligible for a course, you may be removed from it at any time and you will receive no adjustment to your fees. This decision cannot be appealed.

If you find that you do not have the course prerequisites, it is in your best interest to drop the course well before the end of the add/drop period. Your prompt attention to this matter will not only help protect your academic record, but will ensure that spaces become available for students who require the course in question for graduation.

### **Course Objectives:**

This course is an introduction to machine learning for big data sets for use in economic analysis. Machine Learning employs techniques for analyzing large data sets and emphasizes making predictions rather than describing the data. The econometric methods covered in Economics 2222A/B and Economics 2223A/B are extended to common machine learning methods such as random forest and artificial neural networks. The software of instruction is publicly available, and methods will be presented using R (R Studio).

### **Course Learning Outcomes:**

This course is intended to introduce students to the main areas in machine learning and want to apply this understanding to big data.

- Students will learn about how data analysis methods change depending on the desired outcome of the analysis. Students will learn about the distinction between descriptive models (i.e., ordinary least squares) and predictive models, and which is more relevant for your data.
- Students will be introduced to the theory behind several machine learning methods, including:
  - Lasso regression
  - Ridge regression
  - Elastic Net regressions
  - Principal Component Analysis
  - Logistic Regression
  - Decision Trees
  - Random Forests
  - Artificial Neural Networks (ANN)
  - Other ANN algorithms (time permitting)
- Students will apply these methods to big data (many observations) using R (R Studio) and provide their interpretation of the results.
- By the end of the course, students will have demonstrated a solid understanding and competency in R (R Studio), in areas of data management, analysis, and presenting data.

## **Textbook(s) and Course Materials:**

### **Textbook:**

Hastie, T., James, G., Tibshirani, R., and Witten, D. (2009). *“An Introduction to Statistical Learning with Applications in R”*, 1<sup>st</sup> Edition, Springer-Verlag.

<https://www.statlearning.com/>

### **Books for Reference:**

Hastie, T., Tibshirani, R., and Friedman J. (2009). *“The Elements of Statistical Learning: Data Mining, Inference, and Prediction”*, 2<sup>nd</sup> Edition, Springer-Verlag.

<https://web.stanford.edu/~hastie/ElemStatLearn/>

Murphy, K.P. (2012). *“Machine Learning: A Probabilistic Perspective”*, The MIT Press. [Chapter 16]

Michell, Tom M. (1997). *“Machine Learning”*, McGraw-Hill Science/Engineering/Math [Chapters 1 – 4]

Ripley, B.D. (1996). *“Pattern Recognition and Neural Networks”*, Cambridge University Press. [Chapters: 5, 7, and 9]

Wooldridge, Jeffery M. (2019). *“Introductory Econometrics: A Modern Approach”*, Cengage. [General reference for econometrics]

### **Articles:**

Breiman, Leo (1996). *“Bagging Predictors”*, Machine Learning, 24, pp. 123-140.

Breiman, Leo (2001). *“Random Forests”*, Machine Learning, 45, pp. 5-32.

## **Attendance Requirements:**

- Attendance is required for all lectures and laboratories.
- Online Zoom meetings and labs will NOT be recorded.
- Students are responsible for catching up on any missed lectures or labs.

## **Communication:**

- All communication to the entire class will be through the OWL Announcements for the course.
- Students must use their UWO (IVEY) email account for correspondence regarding the course.
- Email responses may take 1-2 business days. Also, the response may be through the OWL Announcements if it pertains to the entire, or a large proportion of the, class.

## **Technical Requirements:**

- Laptop or computer (or use of a campus computer lab)

- R or R Studio installed
- Stable internet connection
- Microphone
- Webcam

For technical support, see the OWL Help page or contact Western Technology Services Helpdesk (<https://wts.uwo.ca/about-wts/contact.html>). Google Chrome or Mozilla Firefox are the preferred browsers for OWL; update your browser frequently.

### **Online Requirements:**

#### Zoom Meetings:

The course content is delivered primarily using OWL. Office hours (and any unscheduled tutorials and synchronous lectures) will be delivered via Zoom. Students will be able to “Join” with a Zoom meeting using the tool on OWL.

Conduct in a Zoom meeting will adhere to guidelines outlined by Western University. Summary of which follows:

- Students must be able to identify themselves in a Zoom meeting. Identification can include, but not limited to: activating student’s webcam for visual confirmation, private message in Zoom Chat to the professor (or TA), or verbal confirmation.
- Students must have a microphone and on mute when joining the Zoom meeting.
- Students will preferably have a webcam available.
- Damaged or malfunctioning technology or low bandwidth that could affect the student’s use of Zoom should be brought to the professor’s attention as soon as possible.

**Failure to identify yourself in a Zoom Meeting will result in your removal from the meeting, and you will be unable to reconnect.**

#### Email:

Primary contact with the professor will be via email ([csaund9@uwo.ca](mailto:csaund9@uwo.ca)) **AND** students must use their Western email account (@uwo.ca). Emails from students using another domain (e.g. @gmail or @outlook) will be ignored.

### **R for Economics:**

On OWL you must join the “R for Economics” site. This site is a self-study online program that allows students to learn R from highly specific short videos (2-5 minutes each). The lessons cover all the major aspects that are used in economics, and relevant methods used for this course.

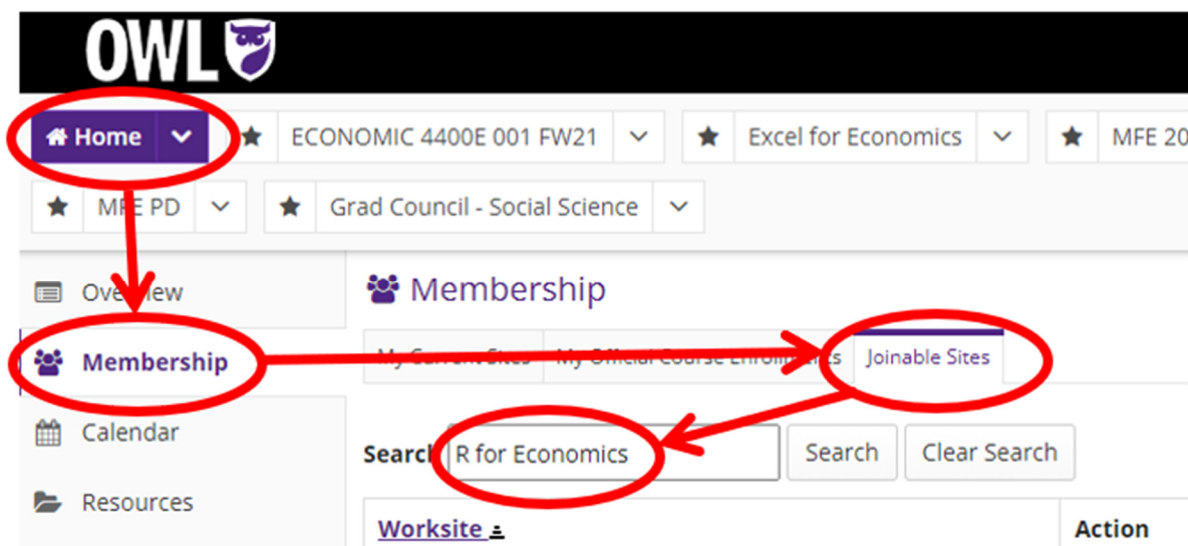
The major topics are:

- Getting started (installing R Studio)
- Basics
- Data manipulation
- Programming
- Plotting and Graphs
- Regressions

- Advanced Estimation
- Machine Learning

The self-study is ordered and should be followed from first to last. (Note the videos were recorded in a slightly different order so some references to other videos may be out of sequence.)

To join R for Economics follow the steps below:



### Assessments and Grading:

Assessment	Grade Contribution	Due date	
R for Economics Quiz Points	10	End of the last lecture	
Labs	20	A calendar week after	
Assignment 1	20	TBD	
Assignment 2	20	TBD	
Assignment 3	20	TBD	
Contribution	10	Weekly	

#### *R for Economics Quiz Points:*

- Progression through the “R for Economics” self-study is tracked by short quizzes that assess your knowledge of commands and your ability to find solutions.
- A student’s accumulated points will determine their grade.

#### *Labs:*

- Each lab will have a short task that can easily be completed during the lab. The labs are designed to assist students to develop the skills required to complete assignments.
- Lab results will be submitted to OWL.

- Students will have up to one calendar week to submit the lab results.

*Assignments:*

- Data for assignments will either be provided or publicly available for download.
- Data will need to be cleaned before analysis.
- Analysis will use the methods outlined above.
- Deliverables will include: a written summary of results, and the R code used.

*Contribution:*

- This portion of a student's grade will be based on a combination of attendance, and participation during lectures or labs.

**SRA or Missed assessments:**

Late assessments without validated reason will receive a mark of zero.

- Self-Reported Absence (SRA), that coincides with an assessment, will result in the assessment being due within 24 hours after the end date specified in the SRA. OWL will show the start and end time and date of SRA assignments and quizzes.
- Absences reported through Academic Counselling, that coincide with an assessment, will result in the assessment be due at a later date. The date will be determined by what is outlined on the accommodation report.

**Professionalism, Privacy and Copyright:**

- Students are expected to follow the [Student Code of Conduct](#).
- All lectures and course materials, including slides, presentations, outlines, and similar materials, are protected by **copyright**. Students may take notes and make copies of course materials for their own educational purposes only.
- Students may not record lectures, reproduce (or allow others to reproduce), post or distribute lecture notes, assessments, or any other course materials publicly and/or for commercial purposes without written consent of the instructor.
- Recordings (audio or video) are not permitted without explicit, written permission of the instructor. Permitted recordings may not be distributed or shared.
- Students will be expected to take an academic integrity pledge before some assessments (*if applicable; otherwise delete this bullet point*) Some sessions may be recorded by the instructor. Recorded sessions will remain within the course site or be unlisted if streamed (*if applicable; otherwise delete this bullet point*)

**Important Dates:**

- Jan 03 – Classes begin
- Feb 19 to Feb 27 – Spring Reading Week
- Feb 21 – Family Day
- Mar 07 – Last day to drop a Winter half-term course
- Apr 01 – Classes end
- Apr 04 to Apr 30 – Final examination period

**Please Note**  
**Department & University Policies for Winter 2022**

The University expects all students to take responsibility for their own Academic Programs. Students should also check their registration to ensure they are enrolled in the correct courses.

1. **Guidelines, policies, and your academic rights and responsibilities** are posted online in the current Western Academic Calendar at: <http://westerncalendar.uwo.ca>. Claiming that “you didn’t know what to do” is not an acceptable excuse for not following the stated policies and procedures.
2. Students must familiarize themselves with the “**Rules of Conduct for Examinations**” [http://www.uwo.ca/univsec/pdf/academic\\_policies/exam/administration.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/exam/administration.pdf).
3. **Cheating as an academic offence:** Students are responsible for understanding what it means to “cheat.” The Department of Economics treats cheating incidents very seriously and will investigate any suspect behavior. Students found guilty will incur penalties that could include a failing grade or being barred from future registration in other Economics courses or programs. The University may impose further penalties such as suspension or expulsion.
4. **Plagiarism:** Students must write their essays and assignments in their own words. When taking an idea/passage from another author, it must be acknowledged with quotation marks where appropriate and referenced with footnotes or citations. Plagiarism is an academic offence (see Scholastic Discipline for Undergraduate Students in the Western Calendar at [http://westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page\\_20](http://westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20)).

Western University uses software to check for plagiarism and students may be required to electronically submit their work. Those found guilty will be penalized as noted in point 3.

5. It is a Department of Economics policy that **NO** assignments be dated, stamped or accepted by staff. Students must submit assignments to the instructor.
6. **Appeals:** University policies and procedures for appealing a mark can be found in the Student Academic Appeals section in the current Western Academic Calendar at: [http://westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page\\_14](http://westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_14). **Please note the relevant deadlines.**

Department of Economics procedures for appealing a mark can be found here: [https://economics.uwo.ca/undergraduate/program\\_counselling/responsibilities\\_policies.html#appeals](https://economics.uwo.ca/undergraduate/program_counselling/responsibilities_policies.html#appeals). The Department will not consider an appeal unless an attempt has been made to settle the matter with the instructor first. Students who remain dissatisfied with the outcome may proceed to submit an appeal to [econugrd@uwo.ca](mailto:econugrd@uwo.ca). Please follow the instructions and use the appeal form shown in the above link.

7. **Systematic adjustments of a class grade distribution** (either up or down) can occur in Economics courses. The fact that grades have been adjusted is **not** grounds for an appeal.
8. Note the following **add and drop deadlines**:

Deadline to <u>add</u> a second term half course:	<b>Tuesday January 18, 2022</b>
Deadline to <u>drop</u> a second term half course:	<b>Monday March 14, 2022</b>

### **Policy Regarding Makeup Tests and Final Examinations**

Faculty of Social Science policy states that oversleeping or misreading an exam schedule is NOT grounds for a makeup. This rule applies to midterm and final exams in the Department of Economics.

### **Policies Regarding Academic Accommodation**

- The Faculty of Social Science's policies on academic accommodation are found at [https://counselling.ssc.uwo.ca/procedures/academic\\_consideration.html](https://counselling.ssc.uwo.ca/procedures/academic_consideration.html)
- **Accommodation for Students with Disabilities:** Students with disabilities or accessibility challenges should work with Accessible Education (formerly SSD, see [http://academicsupport.uwo.ca/accessible\\_education/index.html](http://academicsupport.uwo.ca/accessible_education/index.html)), which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The accommodation policy can be found here: [Academic Accommodation for Students with Disabilities](#).
- **Rewriting Exams and Retroactive Reweighting are NOT Permitted:** Students who proceed to write a test or examination must be prepared to accept the mark. Rewriting tests or examinations, or retroactive reweighting of marks, is **not** permitted. Self-Reported Absences cannot be used once a student has proceeded to start to write a test or exam.
- **Self-Reported Absences:** Students will have two opportunities during the fall and winter terms to receive academic consideration if they self-report a missed assessment using the online self-reported absence portal, provided the following conditions are met: the assessment is missed due to an absence of no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student's final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted otherwise on the syllabus. Students are not able to use the self-reporting option in the following circumstances:
  - for exams scheduled by the Office of the Registrar (e.g., final exams)
  - absence of a duration greater than 48 hours
  - assessments worth more than 30% of the student's final grade
  - if the student has opened or started the test or exam
  - if a student has already used the self-reporting portal twice during the fall/winter terms



If the conditions for a Self-Reported Absence are *not* met, students will need to provide a Student Medical Certificate (SMC) if the absence is medical or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office for more information about the relevant documentation. It is strongly recommended that students notify the instructor as soon as possible, ideally before the assessment, when they become aware of an absence. University policy is that students must communicate with their instructors no later than 24 hours after the end of the period covered by the SMC or immediately upon their return from their documented absence. Failure to follow University policy and procedures may result in denial of academic accommodation and a grade of zero.

- **Documentation for Accommodation:** Individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds or for other reasons. **All required documentation for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.**
- **Western University policy on Consideration for Student Absence** is available here: [Policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs.](#)
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- **Student Medical Certificate (SMC):** This form is available here: [http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/medicalform.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf)
- **Religious Accommodation:** Students should consult the University's list of recognized religious holidays and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the [Western Multicultural Calendar](#).

**Policy Regarding Class Attendance and Engagement:** If the instructor deems a student's attendance or engagement in the class to be unsatisfactory, that student may be prohibited from writing the final examination. Examples of unsatisfactory class engagement include frequent absences from an in-person or synchronous online class, lack of assignment submissions, and inadequate use of online course materials. Instructors who intend to make use of this policy will notify the student in advance.

**Statement on Mental Health and Support Services:** Students under emotional/mental distress should visit [https://uwo.ca/health/mental\\_wellbeing/](https://uwo.ca/health/mental_wellbeing/) for more information and a complete list of resources on how to obtain help.

**Statement on Remote Proctoring:** While Western intends to hold most classes, mid-terms and finals in-person, the London-Middlesex Health unity may require western to teach in a remote format. If this occurs, all assessments will be done remotely and may involve the use of remote proctoring software (i.e., Proctorio, ProctorTrack). Instructors will provide information on the details should the need arise.