

## Economics 497 (L01) (Advanced Econometrics)

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Lecture Location: MS 211  
Lecture Days/Time: TR 11:00-12:15

Office: SS432  
Office Hours: R 12:15-13:15

Winter 2024

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### Course Description:

The purpose of this course is to advance students understanding of theoretical and applied issues in econometrics. Providing students with a strong foundation to carry through with graduate level study in econometrics and learn the skills sought after in the business community. The course takes a broad approach to topics covered but will also focus on current exciting econometric issues. This course will also include an introduction to Python, though students are expected to have some experience with econometric software already (not necessarily Python). We will also discuss prediction and classification models that are used in Data Science. By the end of the class students will have extensive experience in applying different data analysis methods, and in using experimental and nonexperimental research designs to make inferences.

### Course Learning Outcomes:

This course will emphasize the notion of “research design”: how to set up a study to answer a particular question, typically about the causal effect of some variable  $X$  on some outcome  $Y$ . Students will be provided with knowledge of the major research designs used in applied economics, and how to understand the various assumptions upon which each of them relies. After successful completion of the course, students will:

- A) Know and understand the notion of causal inference based on the potential outcomes model
- B) Understand the concept of selection bias and how to assess it as a threat to causal inference
- C) Understand the notion of randomization as a “gold standard” solution for selection bias
- D) Know the statistical properties of the  $k$ -variable regression model, and how to apply them for hypothesis testing
- E) Understand regression as a tool to estimate causal effects, and evaluating the necessary assumptions
- F) Know the assumptions required to use alternative “quasi-experimental” methods: including instrumental variables, regression discontinuity designs, and difference-in-differences, and how to assess whether a given setting lends itself to one of these research designs.
- G) Have familiarity with machine learning methods as a tool for prediction and classification.

### Course Outline:

Section 1: Introduction to causality and potential outcomes, treatment effects, selection bias, and randomized experiments.

Section 2: Linear regression as a method to conduct inference about causal effects. This will involve a review of OLS and its statistical properties.

Section 3: Instrumental variables as a method to conduct inference about causal effects, both when treatment effects are homogenous and when they are heterogenous.

Section 4: Regression discontinuity and regression kink designs.

Section 5: Panel data methods, difference-in-differences.

Section 6: Using machine learning methods for prediction, classification, and causal inference.

**Prerequisites/Corequisites:**

Economics 495 and Mathematics 211.

**Required Textbook(s):**

Heiss, F. and Brunner, D. *Using Python for Introductory Econometrics*. Free electronic version:

<http://www.upfie.net/>

Cunningham, S.: *Causal Inference: The Mixtape*. Free online textbook

<https://mixtape.scunning.com/>

**Recommended Textbook(s):**

Angrist, J.D. and Pischke, J., *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.

Wooldridge, J.M., *Introductory Econometrics: A Modern Approach*, South-Western.

For the machine learning portion of the course, I will rely on free online references and notes that will be distributed. Students may find the following book useful: Burkov, Andriy, *The Hundred Page Machine Learning Book*.

**Required Access to Technology:**

Excel, STATA, R, Julia, or Python

**Desire2Learn:**

This course will make use of the Desire2Learn (D2L) platform. Students who are registered in the course can log on at <http://d2l.ucalgary.ca> through their student centre. Please note that D2L features a class e-mail list that may be used to distribute course-related information. These e-mails go to your University of Calgary e-mail addresses only.

**Grade Determination:**

Midterm Exam	15%
Assignments	30%
Term Project	20%
Final Exam	35%
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	100%

**Examination Details:**

Tests and exams WILL NOT involve multiple choice questions.

Programmable calculators, cellphones, textbooks, course notes, and other electronic devices will not be allowed during the writing of tests or final examinations. USE OF SIMPLE CALCULATOR IS ALLOWED. Students are reminded that simply being able to access their cellphone during an exam is academic misconduct.

The midterm exam takes place on **Thursday, February 15**, in the regular classroom during the class time.

**Grading Policies:**

The official grading system will be used. See <http://www.ucalgary.ca/pubs/calendar/current/f-1-1.html>.

Students must receive a passing grade on the final exam to pass the course. Students committing academic misconduct during the final exam will not receive a passing grade for the course.

If a student's letter grade on the final exam exceeds their midterm(s) letter grade, the weight of the midterm(s) is (are) transferred to the final exam. The student must have written the midterm(s) or provided supporting documentation for the absence(s).

As per the Writing Across the Curriculum Statement in the Calendar, writing and grading thereof will be a factor in the evaluation of student work. See <https://www.ucalgary.ca/pubs/calendar/current/e-2.html>.

THERE WILL BE NO MAKEUP OR DEFERRED QUIZZES/TESTS/EXAMS under any circumstances, nor may the quizzes/tests/exams be written early. Students unable to write the quizzes/tests/exams because of documented illness, family emergency, religious observance, or university-sanctioned event will have the weight shifted to the final examination; otherwise a grade of zero will be assigned.

The final examination will be comprehensive, scheduled by the Registrar, held in a classroom, and last 2 hours. If a student cannot write their final exam on the date assigned by the Registrar's Office, they need to apply for a deferred exam <https://www.ucalgary.ca/pubs/calendar/current/g-3-4.html>. Under no circumstance will this be accommodated by the Department.

Any student work which remains undistributed after the last day of classes will be available to students through the instructor's office during the instructor's office hours.

**Reappraisal of Grades:**

*For Reappraisal of Graded Term Work, see Calendar I.2*

<http://www.ucalgary.ca/pubs/calendar/current/i-2.html>

*For Reappraisal of Final Grade, see Calendar I.3*

<http://www.ucalgary.ca/pubs/calendar/current/i-3.html>

**Academic Misconduct and Intellectual Honesty:**

Academic Misconduct refers to student behavior that compromises proper assessment of students' academic activities and includes: cheating; fabrication; falsification; plagiarism; unauthorized assistance; failure to comply with an instructor's expectations regarding conduct required of students completing academic assessments in their courses; and failure to comply with exam regulations applied by the Registrar.

*Statement of Intellectual Honesty, see Calendar K.3*

<https://www.ucalgary.ca/pubs/calendar/current/k-3.html>

*Plagiarism and Other Academic Misconduct*

<https://ucalgary.ca/student-services/student-success/learning/academic-integrity>

Academic Accommodations:

Students seeking an accommodation based on disability or medical concerns should contact Student Accessibility Services. SAS will process the request and issue letters of accommodation to instructors. Students who require an accommodation in relation to their coursework based on a protected ground other than disability should communicate this need in writing to their instructor. The full policy on Student Accommodations is available at

<https://www.ucalgary.ca/legalservices/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf> and <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Student-Accommodation-Policy.pdf>.

Freedom of Information and Protection of Privacy (FOIP) Act:

Personal information is collected in accordance with FOIP. Assignments can only be returned to the student and will be accessible only to authorized faculty and staff. For more information, see <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/faq-privacy-faculty-members.pdf> and <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/faq-privacy-students.pdf>

Internet and Electronic Communication Device Information:

The use of cell phones for any purpose in class is prohibited. Computers and tablets may be used for note taking only unless otherwise authorized by the instructor.

Copyright Legislation:

See the University of Calgary policy on Acceptable Use of Material Protected by Copyright at <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Acceptable-Use-of-Material-Protected-by-Copyright-Policy.pdf>. Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy.

Recording of Lectures:

Recording of lectures is prohibited, except for audio recordings authorized as an accommodation by SAS or an audio recording for individual private study and only with the written permission of the instructor. Any unauthorized electronic or mechanical recording of lectures, their transcription, copying, or distribution, constitutes academic misconduct. See <https://www.ucalgary.ca/pubs/calendar/current/e-6.html>.

Instructor Intellectual Property:

Course materials created by instructors (including presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the instructor. These materials may NOT be reproduced, redistributed or copied without the explicit consent of the instructor. The posting of course materials to third party websites such as note-sharing sites without permission is prohibited. Sharing of extracts of these course materials with other students enrolled in the course at the same time may be allowed under fair dealing.

Important Dates:

Please check: <http://www.ucalgary.ca/pubs/calendar/current/academic-schedule.html>.

**Student Organizations:**

Faculty of Arts Students' Association (F.A.S.A.):

Economics Department Representative

Office: SS 803, E-mail: [econrep@fasaucalgary.ca](mailto:econrep@fasaucalgary.ca) and Web: [www.fasaucalgary.ca](http://www.fasaucalgary.ca).

Society of Undergraduates in Economics: <https://www.ucalgarysue.com/>.

Society of Undergraduates in Economics is a student run organization whose main purpose is to assist undergraduate economics students to succeed both academically and socially at the University of Calgary. Services include access to the exam bank, career events such as Industry Night and information sessions, mentorship programs, and social events for members. They invite you to join by contacting SUE at [sue@ucalgarysue.com](mailto:sue@ucalgarysue.com)

**Faculty of Arts Program Advising and Student Information Resources:**

- Have a question, but not sure where to start? The Arts Students' Centre is your information resource for everything in Arts! Drop in at SS102, call them at 403-220-3580, or email them at [artsads@ucalgary.ca](mailto:artsads@ucalgary.ca). You can also visit the Faculty of Arts website at <http://arts.ucalgary.ca/undergraduate>, which has detailed information on common academic concerns, including program planning and advice.
- For registration (add/drop/swap), paying fees and assistance with your Student Centre, contact Enrolment Services at 403-210-ROCK [7625] or visit them in the MacKimmie Tower.

**Student Support and Resources:**

- See <https://www.ucalgary.ca/registrar/registration/course-outlines> for information on campus mental health resources, the Student Ombuds Office, Student Success Centre, Safewalk, and Emergency Evacuation and Assembly.
- Online writing resources are available at <https://ucalgary.ca/student-services/student-success/writing-support>.

**Notes:**

- Students are responsible for all assigned material, e.g., supplementary material posted on D2L, regardless of whether or not the material was covered in class.

**Classes**

- All the class material will be posted to the Desire2Learn (D2L) platform.
- The material covered in each lecture will be found in one D2L file named "Date" (e.g. Folder "October 1" will contain all the materials covered on October 1). The lecture slides and lecture notes become available on D2L before the lecture.

**Communication**

- When students need to contact the instructor by email, **email both your TA and the instructor**. The TAs will help us communicate efficiently. We will get back to you within 2 business days. If a student has concerns about personal issues that need to be addressed immediately, use the word "[Urgent]" in the email title.

- All the announcements made in class will be posted on D2L Newsfeed. Important/urgent announcements will also be sent to you by email using the class mail-list.
- When students have questions related to the class material, the best way is to post their questions on the D2L discussion forum. We will get back to you within one business days. Students can post questions anonymously.

### Assignments

- Submit your assignments to the D2L Quizzes section before the due date. **Late assignments or assignments sent by e-mail will not be accepted.**
- You are encouraged to work with your classmates. However, you need to **write in your own words**. If we find nearly identical submissions, both students will receive 0, regardless of who helped who.
- Assignments Formatting Requirements:
  - Submit your assignments as ONE file unless specified otherwise. Compressed folders (e.g. .zip or .pages) do not count as single files. If you are uploading photos of your work, please transform them into a format recognized by Windows (e.g. JPEG, PNG or PDF format). *Please do not submit files with .heic extension.*
  - Include your family name and the assignment number in the name of the file you upload to the Quizzes section in the following form: LASTNAME\_hw# where you will substitute the assignment number for the # in the filename.
  - You can scan your written homework with a scanner or your device's camera to create scanned pdf files. Before you submit your scanned homework, be sure to verify that the scan is easily readable.
  - Make sure that the pages are in the correct order; that is, the first page of the document should be the first page of your work and so on. Make sure that the pages are aligned properly; that is, pages are not in a landscape position.
  - It is recommended that you submit a draft at least one day before the due date. If you want to make a change, you can upload the whole file as a new submission in the same folder--- **your grade will be based on the most recent submission.**

### Other Notes

- The weight of the midterm can be shifted to the final exam if the **letter** grade for the final is higher than the midterm. However, the weight of the final exam **cannot** be shifted to the midterm. The final exam is harder than the midterm exam. Try not to miss the midterm exam.
- The weight of the assignments or term project **cannot** be shifted to the other components.