

## Economics 497 (L01) (Advanced Econometrics)

Instructor: Leonard Goff  
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Lecture Location: MS 217  
Lecture Days/Time: Tues/Thurs 11:00 - 12:15

Office: SS 408 (Zoom office hours possible by request)  
Office Hours: 1-3pm Tuesdays

Winter 2023

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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):**

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

**Recommended Textbook(s):**

Heiss, F. and Brunner, D. *Using Python for Introductory Econometrics*. Free electronic version: <http://www.upfie.net/>

Wooldridge, J.M., *Introductory Econometrics: A Modern Approach*, South-Western. Purchasing this book is not necessary for the course, but pairs with the Python book mentioned above as a nice reference.

Students may also find the free online textbook Cunningham, S.: *Causal Inference: The Mixtape* useful: <https://mixtape.scunning.com/>

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*.

**Books on Reserve:**

The list of reserve titles, if any, is posted at the course D2L site.

**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          | 25%        |
| Assignments           | 30%        |
| In class presentation | 10%        |
| FINAL EXAM            | <u>35%</u> |
|                       | 100%       |

**Examination Details:**

Tests and exams will not involve multiple choice questions, but may questions that ask students to assess whether a statement is true/false.

Programmable calculators and a formula sheet will be allowed during the writing of tests or final examinations. Students are reminded that simply being able to access their cellphone during an exam is academic misconduct.

The exact date for the in-class midterm will be announced at least one week in advance.

**Term Work:**

There will be four homework assignments. The lowest assignment grade will be dropped and the letter grades on the other three will count towards the final class grade. The in-class presentation will require reading a published research paper and presenting its approach and findings from an econometrics perspective.

**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). For Winter 2023 the University has suspended the requirement for supporting documentation. Instructors cannot currently ask students for documentation to support absences.

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>.

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.

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-6.html>. Under no circumstance will this be accommodated by the Department.

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.

**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.4*

<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 policies on Student Accommodations are available at <https://www.ucalgary.ca/legal-services/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 Library Block.

**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:**

1. 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.

LTG

2022-12-08