UNIVERSITY OF CALGARY

Department of Economics
Faculty of Arts

Economics 497 (L01) (Advanced Econometrics)

Instructor: Arvind Magesan
Phone: 220-5276
Email: anmagesa@ucalgary.ca

Office: SS430
Office Hours: Friday 9-10

Lecture Location: EDC 054
Lecture Days/Time: TR 11:00-12:45

Winter 2022

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 industry. The course takes a broad approach to topics covered but will also focus on current exciting econometric issues. Students will be expected to have working knowledge of STATA and will receive instruction on Python. The first half of the course will be spent developing the modern framework and methodology for causal inference in economics, and the second half course will cover methods for machine learning, including the workhorse 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. This course starts at a level that assumes familiarity with the material covered in Econ 495 and Stats 213, including proficiency at mathematical statistics and calculus. Matrix algebra is used extensively in lecture presentations.

Course Learning Outcomes:

a) Know and understand the k-variable regression model.

b) Be proficient in standard model applications and testing.

c) Know, understand and be able to prove the Gauss-Markov theorem.

d) Be able to identify and correct violations to identification and hypothesis testing.

e) Know and understand standard panel data models allowing for fixed effects.

f) Know and understand the differences between fixed and random effects estimators.

g) Know and understand way a randomized experiment allows for a casual interpretation of empirical results.

h) Know and understand how non-experimental techniques allow for a casual interpretation of empirical results.

i) Know and understand the use of instrumental variables, difference in differences, matching estimators and discontinuity in identification.

j) Know and understand the maximum likelihood estimators used in non-linear estimation.

k) Be proficient in application of prediction, cross validation and classification models.

l) Be proficient in reporting, interpreting, and drawing policy implications from econometric results.

Course Outline:
Broadly, there are two main sections of the course. The first section provides a comprehensive treatment of current econometric methods for causal inference using non-experimental data. The second section introduces students to the theory and practice of machine learning. Significant time in this second section will be spent on learning how to write code in Python. A more detailed breakdown is as follows:

Section 1: Methods for Causal Inference

1. The theoretical concept of causality and the "experimental ideal"
2. The workhorse of econometrics: The Linear Regression model. Review and advanced topics.
3. Advanced topics in Instrumental Variables. Local Average Treatment Effects (LATE).
4. Difference in Differences. Synthetic control.
5. Regression Discontinuity: "Sharp" and "Fuzzy" designs.

Section 2: Machine Learning
1. Introduction to machine learning. Relationship to causal inference.
2. Python – How to write code in Python. Examples using regression.
3. Machine Learning for Prediction. Linear regression-based prediction models. K-fold cross validation.
4. Machine Learning for Classification. K-Nearest neighbors. Decision Trees. Logistic Regression
5. Introduction to Unsupervised learning.
6. Time permitting: Web scraping and Text analysis in Python.

Prerequisites/corequisites:
Econ 497 starts at a level that assumes familiarity with the material covered in Econ 495 and Stats 213, including proficiency at mathematical statistics and calculus. Presentations will extensively use linear algebra. Students are expected to be familiar with Stata software for econometrics. No experience with Python is expected – we will "start from scratch."

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

Recommended Textbook(s):
Wooldridge, J.M., *Introductory Econometrics: A Modern Approach,* South-Western.

There is no required textbook for the machine learning section, I will provide detailed notes. Students may find the following book useful:

Burkov, Andriy, *The Hundred Page Machine Learning Book.*

Books on Reserve:
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.

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 and Final Examination Details:

Assignments	40%
Midterm Exam	20%
Final Exam	40%
	100%

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

A passing grade on any particular component of the course is not required for a student to pass the course as a whole.

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 at the discretion of the instructor. The student must have written the midterm(s) or provided supporting documentation for the absence(s) such as a medical note or statutory declaration.

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.

Course material dealing with a particular assignment will typically be covered in class at least 3 days before the assignment is due; thus, assignments can be completed at any time up to and including the due date. Given these factors, only situations where someone can document illness or domestic affliction for an extended period (i.e., the entire 3 days prior to the due date) would possibly warrant shifting the assignment weight to the final exam. Furthermore, technical problems can be expected to occur with computer systems (and internet availability) so it may be a good idea to not wait until the last minute to submit your assignment.

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.

Tests and exams WILL NOT involve multiple choice questions.

Cellphones, textbooks, course notes, and other electronic devices will not 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.

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:
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.

Student committing academic misconduct during the final exam will not receive a passing grade for the course.

For information on the Student Academic Misconduct Policy, Procedure and Academic Integrity, please visit: https://www.ucalgary.ca/pubs/calendar/current/k-3.html

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/legal-services/university-policies-procedures/accommodation-students-disabilities-procedure

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/access-information-privacy

Copyright Legislation:
See the University of Calgary policy on Acceptable Use of Material Protected by Copyright at

https://www.ucalgary.ca/legal-services/university-policies-procedures/acceptable-use-material-protected-copyright-policy Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy.

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.

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.

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
E-mail: econrep@fasaucalgary.ca
Website: 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 societyofundergradsineconomics@gmail.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. 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:

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.

ANM
2021-12-06