ECO 372H1F LEC0101 / LEC0201:
Data Analysis and Applied Econometrics in Practice

Instructor: Gustavo J. Bobonis

Department of Economics
University of Toronto
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I. Course Description

ECO372 Data Analysis and Applied Econometrics in Practice is an intermediate level course in econometrics for students at the University of Toronto (St-George campus). Its goal is to equip students with a modern approach to data analysis and econometrics, focusing on the use of data and regression-based analysis to answer causal questions. Students will learn about different empirical techniques that economists use to do so: random assignment, linear regression, matching, difference-in-differences, instrumental variables, and regression discontinuity design. Students will learn about applications of these techniques in academic research; empirical examples will be drawn from work in labour, education, development, and public economics. Students will also put these techniques in practice and gain familiarity with Stata, one of the most widespread statistics software in economics.

II. Key Information

Course site: ***Quercus*** (all announcements and material)
Calendar: see ***Quercus*** homepage
https://q.utoronto.ca/courses/311430
https://q.utoronto.ca/courses/311437

Instructor: Gustavo J. Bobonis
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Instructor Drop-in Office Hours: Monday 10.00-12.00 on ***Zoom*** (access from ***Quercus***)
Communication: see **Communication** below

All announcements will be made using *Quercus*. All material will be posted on *Quercus*.

III. Learning Outcomes

By the end of this course you should be able to:

1. Understand the notion of causality and its importance in applied empirical research.

2. Identify five (5) strategies that can be used to answer causal questions using data: random assignment, regressions and matching, instrumental variables, difference-in-

differences, and regression discontinuity design, and their associated regression specification.

3. Clearly articulate each method's requirements, typical use, and limitations, and know how to interpret their quantitative results.

4. Read unfamiliar research papers and understand the research question and basic estimation strategy / econometric model used to answer it.

5. Interpret and comment on tables of estimated coefficients from a wide range of econometric models, in various formats.

6. Use your understanding of the methods to assess the validity and quality of empirical studies, including the ability to judge whether a method may or may not work in a specific research context.

7. Articulate short well-crafted arguments to answer questions regarding each of these methods.

8. Reproduce key results of empirical papers using Stata.

9. Apply these methods to actual datasets, using Stata programming language.

IV. Prerequisites

Microeconomic Theory – ECO200Y1 / ECO204Y1 / ECO206Y1
Quantitative Methods in Economics – ECO220Y1 / ECO227Y1 / (STA237H1, STA238H1) / (STA247H1, STA248H1) / (STA257H1, STA261H1)

Exclusion: ECO351H1

Note: Prerequisites are strictly checked and enforced and must be completed before taking this course. By taking this course you acknowledge that you will be removed from the course at any time if you do not meet all requirements set by the Department of Economics. Please talk to Ms. Sally Wong (Undergraduate Administrator, Department of Economics) if you have any doubt about whether you meet the requirements.

I expect that you will be able to perform basic calculus (i.e., take simple partial derivatives). The TA will offer brief reviews of the more advanced background material.

V. Textbook (required) and Readings (required)

Cunningham, Scott (2021). ***Causal Inference: The Mixtape***. Yale University Press: New Haven & London. 352pp. ISBN: 9780300255881.

It is available at ***UofT Library*** (***online***)
https://www-degruyter-com.myaccess.library.utoronto.ca/document/doi/10.12987/9780300255881/html

as well as on Amazon, Indigo and many other online platforms. I strongly recommend that you buy your own copy. Not only is it an engaging and accessible book, but it is also one that can stay useful for a lifetime.

The course will follow the textbook pretty closely, although not in the original order. I will post the required readings ahead of each lecture, which will include parts of the book and additional readings (typically research papers).

A central part of the course will be selected journal articles that illustrate the various empirical strategies and methods that we will be discussing. The articles will be drawn broadly from empirical microeconomic fields, and the course will therefore have "economic content" in addition to the focus on applied econometrics. A more complete list of the readings is listed below. Most articles will be available through Quercus.

All assigned readings are examinable, and you should read the material before each lecture and come prepared to lecture. First, you will not be able to follow the lectures if you do not do the readings ahead. Second, regular work is much more efficient than last-minute cramming.

VI. Course Delivery & Meetings (Lectures, Group Sessions, and Tutorials)

Our *workweeks* run from *Monday* to *Friday* (see *Quercus* homepage for details). See the Course calendar for the list of topics and readings; the calendar is subject to (limited) changes. Content is organized by *workweek*.

(a) A new set of modules will be made available every *Monday*. A module typically comprises lecture slides and required readings.

(b) Lecture, **discussions** and **Q&A** sessions will follow during each 2-hour lecture period (Wednesdays), and

(c) One-hour **tutorials** with the TA (Thursdays).

For each *week*, you are expected to complete the readings and review the lecture slides in advance of lectures and group sessions, work on the tutorial, participate in group discussions, and complete assignments by their due dates. I expect a time commitment of 10 hours a week.

Tutorials

The one-hour tutorial will be dedicated to practice material from the current or previous *week*'s lecture and/or get hands-on Stata experience. Each tutorial is an opportunity to discuss readings and put to practice the methodologies seen in class with hands-on Stata experience. For Stata tutorials, it is important that you bring a laptop with Stata installed on it (see Stata and laptop).

In-class Behavior

To keep group meetings and tutorials as useful and productive as possible, I ask you to keep a professional and adequate attitude in class, in order to limit disruptions to other students (and to the instructors). This includes: arriving on time (or being discrete if you if you have to enter the room late), not chatting with your classmates (except related to course material), not visiting websites, watching or listening to other media, not texting/messaging. I do not like reminding students about this, but I will if I have to.

Office Hours

Office hours will take place online each week, at a time different than the class time slot (see details on *Key Information*). Hands-on help (office hours/Stata help) will be delivered online during these times and those of the TA (TBD).

Stata (required) and laptop (recommended)

One objective of the course is to get students to perform analyses using statistical software. Some tutorials will provide hands-on experience to Stata, one of the most widely used statistics software in the world. Each student is expected to come with their own laptop.

Stata is a proprietary commercial software, available on Windows, macOS and Linux. It comes in several "flavours" of increasing memory capacity, but for the purpose of this course, the simplest Stata/IC is sufficient. A 6-month license to Stata/IC for students costs 48 USD (make sure to click on the 6-month tab). (You are free to buy a more expensive flavour or a longer license, but it is unnecessary for this course. Do NOT buy Small Stata.) If you already have Stata version 14 or above, you do not need to buy the latest version, as most commands we will use haven't changed. Stata 13 is unable to open datasets provided for the tutorials and assignments.

Stata is also available on computers of the Map and Data Library room at Robarts Library; it is your responsibility to adequately transfer your files.

VII. Evaluation

Evaluation for the course is a mix of take-home assignments, a midterm test, and the final exam. The breakdown is as follows. The final course grade will be rounded to the nearest integer, with no exception.

Evaluation	Date	Percentage of Final Grade
Assignment #1	Week 3	6%
Assignment #2	Week 5	6%
Assignment #3	Week 7	6%
Midterm Test	Week 8	35%
Assignment #4	Week 9	6%
Assignment #5	Week 11	6%
Final Exam	Final Exam Period	35%

Assignments

There are five assignments to hand in. These exercises involve a mix of algebra, questions on research articles, performing statistical analyses using Stata, and writing about your analysis in a clear rigorous way. You will be graded on the quality and clarity of your answers.

For every assignment, you will be asked to submit three documents:

- a PDF containing the answers to your questions, with the adequate explanations and interpretations
- the code (do-file) that you used for the analysis, duly commented (instructions will be posted on Quercus);
- the log file automatically generated by your code.

You will have to upload these documents before the deadline on Quercus.

Students may use artificial intelligence tools, including generative AI, in this course as learning aids or to help produce assignments. However, students are ultimately accountable for the work they submit.

● Students must submit, as an appendix with their assignments, any content produced by an artificial intelligence tool, and the prompt used to generate the content.

● Any content produced by an artificial intelligence tool must be cited appropriately. Many organizations that publish standard citation formats are now providing information on citing generative AI (e.g., MLA: https://style.mla.org/citing-generative-ai/).

● Students may choose to use generative artificial intelligence tools as they work through the assignments in this course; this use must be documented in an appendix for each assignment. The documentation should include what tool(s) were used, how they were used, and how the results from the AI were incorporated into the submitted work.

● Note that some generative AI applications may require a subscription fee. Students may opt-out of using a system if they have concerns about the cost, privacy, security or other issues related to this technology.

Mid-Term Test and Final Exam

For the term test and the final exam, bring your TCard, pencils, and erasers.

For the midterm test and the final exam, one or more questions (possibly with multiple parts) is planned to require a longer written answer where you interpret and assess quantitative results (e.g. tables, figures, Stata output, etc.).

During the test you must show your student ID and sign the “signup sheet”. Stay seated until all tests have been collected and counted. To avoid disruption, you cannot leave the room in the last 15 minutes. The midterm test and exam begin at the official start time. You must be in the exam room no later than 5 minutes before official start time. You will not be given extra time if you are late.

The centerpiece of the test and the exam will be the theoretical and empirical issues covered in the context of the course readings and class discussions. The final examination will be cumulative.

Class Participation (Bonus)

Students will be evaluated on class participation. The performance will largely be based on students having read required readings prior to class and being prepared to engage in a meaningful discussion on the book chapters and articles during class time.

Missed Term Work

You are expected to complete all required work as scheduled in the Evaluation section. Assignments dates and instructions are posted well in advance, and it is your responsibility to ensure adequate time to complete the work and deal with any issues, including technical issues. Failure to submit an assignment will result in a grade of zero.

Assignments are considered submitted by the time all the files have been uploaded in the correct format to Quercus according to the assignment instruction. Assignments that are submitted late will suffer a penalty of 10 percentage points per day of lateness, starting immediately at the deadline (by the deadline). Make sure to allow ample time for submission before the deadline; excuses such as: “the website is slow”, “I only submitted one minute late”, “I forgot to upload one of the files”, etc. are not valid excuses. These

rules are there to limit unwarranted individual requests.

Appeals Policy

Appeals will be conducted according to the following procedure:

- For any assignment or test, if a student wishes to appeal a grade, he/she must provide a written explanation of why they believe their grade is mistaken and submit it to me within one week of the document being returned to the class.
- Conditional on this argument being found persuasive by the instructor, it is likely that the entire assignment/test will be re-graded, and the appealed grade can be lower or higher than the original grade. Note: This does not apply to trivial appeals such as points being added incorrectly.

Academic Skills Resources

Even the most seasoned, organized and dedicated student can benefit from speaking with a Learning Strategist to explore setting achievable goals, preparing for tests and time management strategies. You can schedule an appointment with a Learning Strategist at any time of the year.
https://sidneysmithcommons.artsci.utoronto.ca/can-a-learning-strategist-help-me/

VIII. Calendar and Planned Coverage

The authoritative calendar is the one posted on the Quercus course page. The due dates are definitive, but topics might be adjusted; all announcements will be made on Quercus.

Planned Coverage

We will follow the material outlined in Cunningham (2021) very closely, together with other readings related to applications of the different methods.

1. Introduction and Motivation
    A. Empirics in Economics and Understanding Causality
    B. Regression Fundamentals
    C. Review of Ordinary Least Squares and Regression Analysis (CEF, OVB)

2. Causal Inference, the Fundamental Problem
    A. Rubin Causal Model
    B. The Selection Problem (OVB and Endogeneity)
    C. ATE, ATT, and the Experimental Ideal

3. Inference (Basic Issues with Standard Errors)
    A. Inference in Experimental Ideal
    B. Clustered Design

4. Matching and Subclassification
    A. Selection on Observables and Conditional Independence
    B. Matching, Comparing Matching to Regression
    C. Propensity Score Methods

5. Instrumental Variables
    A. Selection on Unobservables

B. Wald Estimator, IV, and 2SLS
C. Heterogeneous Treatment Effects, Compliance, Intent-to-Treat Effects (ITT)
D. Local Average Treatment Effect (LATE) (and Treatment-on-the-Treated (ATT))

6. Regression Discontinuity Design (RDD)
   A. Sharp and Fuzzy RDD
   B. Challenges to Identification

7. Differences-in-Differences and Panel Data
   A. Differences-in-Differences
   B. Challenges to Identification
   C. Event Study and Synthetic Control
   D. Panel Data

8. Other Topics
   A. Spillovers and Externalities
   B. Attrition and Partial Identification

IX. Communication

I tend to use Quercus extensively as a means of communication with the class, so I recommend you check the announcements regularly.

E-Mail

Please feel free to email me questions or comments pertaining to the course, with the following proviso:

(1) The answer requires a one or two-line response (maximum). It is my experience that email is an inefficient way to discuss economics. Questions that require more than one or two-line answers are more appropriate for office hours.

(2) I will normally reply to emails within 24 hours, except on weekends.

(3) I will not answer emails regarding information that can be found in the syllabus or on the Quercus page, questions about grades, or questions about the course material (which should be posted on Quercus).

Please do not send attachments and do not submit term work by email. Please always include [ECO372] in the title of any email. Emails that do not include this will be ignored.

X. Student Well-Being and Academic Accommodations

Well-Being

University of Toronto aims at giving you an enriching learning experience, and has resources to help you stay healthy and be well: *http://studentlife.utoronto.ca/bewell*

However, sometimes things do not go as planned. **In case of emergency, call 911.** For ongoing injury, illness, or personal/family problems, or if you feel you are falling behind in your courses, you must contact your College Registrar immediately. The earlier you do, the easier it is to find solutions.

There are also a number of resources in case you are feeling distressed:
http://studentlife.utoronto.ca/feeling-distressed

Once again, the earlier you reach out, the easier it is to remedy the situation and find solutions. Do not wait until the end of the academic year.

Ongoing Learning Disability or Accommodation Requirement

Students with diverse learning styles and needs are welcome in this course. If you have an ongoing disability issue or accommodation need, you should register with Accessibility Services (AS) (*http://accessibility.utoronto.ca*) at the beginning of the academic term. (Without registration, you will not be able to verify your situation with your instructors, and instructors will not be advised about your accommodation needs.) AS will then assess your medical situation, develop an accommodation plan with you, and support you in requesting accommodation for your course work. Remember that the process of accommodation is private: AS will not share details of your condition with any instructor, and your instructors will not reveal that you are registered with AS.

For more information on services and resources available to instructors and students, please contact Tanya Lewis, Director, Director of Academic Success and Accessibility Services, at (416) 978-6268; *tanya.lewis@utoronto.ca*.
Accessibility services: *http://studentlife.utoronto.ca/as/*

Accommodations for Religious Observances

As a student at the University of Toronto, you are part of a diverse community that welcomes and includes students and faculty from a wide range of backgrounds, cultural traditions, and spiritual beliefs. For my part, I will make every reasonable effort to avoid scheduling tests, examinations, or other compulsory activities on religious holy days not captured by statutory holidays. Further to University Policy, if you anticipate being absent from class or missing a major course activity (like a test) due to a religious observance, please let me know as early in the course as possible, and with sufficient notice (at least two to three *weeks*), so that we can work together to make alternate arrangements.

XI. Academic Integrity

All students, faculty and staff are expected to follow the University's guidelines and policies on academic integrity. For students, this means following the standards of academic honesty when writing assignments, citing and using source material appropriately, collaborating with fellow students, and writing tests and exams. Ensure that the work you submit for grading represents your own honest efforts. Plagiarism, representing someone else's words as your own or submitting work that you have previously submitted for marks in another class or program, is a serious offence that can result in sanctions. Speak to me or your TA for advice on anything that you find unclear. Also, see the U of T writing support website at *http://www.utoronto.ca/writing*. Consult the Code of Behaviour on Academic Matters (*http://www.governingcouncil.utoronto.ca/policies/behaveac.htm*) for a complete outline of the University's policy and expectations.

Potential offences include, but are not limited to:

- In papers and assignments:
    - Using someone else's ideas or words without appropriate acknowledgement. This includes verbatim copying of any lecture notes distributed by the instructor.

    - Submitting your own work in more than one course without the permission of the instructor.
    - Making up sources or facts.
    - Obtaining or providing unauthorized assistance on any assignment.

- On tests and exams:
    - Using or possessing unauthorized aids, including smartphones.
    - Looking at someone else's answers during an exam or test.
    - Misrepresenting your identity.

- In academic work:
    - Falsifying institutional documents or grades.
    - Falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes.

I do encourage you to pay close attention to these sections on Perils and Pitfalls *http://academicintegrity.utoronto.ca/perils-and-pitfalls* and Smart Strategies *http://academicintegrity.utoronto.ca/smart-strategies*.