# University of Waterloo
## Department of Economics
## ECON 484/673: Econometric Methods for High-Dimensional Data
## Winter 2022

**Lecture time/location:** Tuesday and Thursday, 1:00pm - 2:20am, HH 334
**Instructor:** Tom Parker
**Course website:** link
**Office:** HH 206
**Office hours:** Thursdays, 3pm - 4pm or by appointment
**Email:** tmparker@uwaterloo.ca

## Course Objectives

In this course, you will learn about data analysis techniques that are useful for complex models of economic behaviour in data-rich environments. We will discuss penalized regression and classification methods and how to examine the uncertainty in statistical estimators. Then we will turn to quasi-experimental methods with observed data and the way that penalized methods can be used to find the causal impact of policies. Finally, we will discuss dimension reduction and nonparametric methods for measuring relationships in high-dimensional data such as text analysis.

## References

This course will follow the basic outline of the first reference below. However, course material will also be drawn from the second reference, which is very helpful if this is your first exposure to these methods. Neither is mandatory.

- M. Taddy (2019). *Business Data Science*, McGraw Hill.
- G. James, D. Witten, T. Hastie and R. Tibshirani (2021). *An Introduction to Statistical Learning*, Springer.

The James et al. book (ISL) is available freely from an accompanying website. The course is designed with the first edition of ISL (from 2014) in mind, but if we have time, I may cover one or two topics from the new edition at the end of the course.

The examples in the notes use R, a freely available statistical software package. You are not required to use a particular software package for assignments, although I encourage you to learn R. It is easy to use and popular among social scientists. Everything you can do with R you can also do with Python, which is worth considering as your chosen language, although I cannot provide the coding support for new Python users that I can for new R users.

## Topics

1. Basic inference and resampling (2 weeks)
2. Regression and regularized regression estimators (2 weeks)
3. Classification (1 week)
4. Methods for causal inference (3 weeks)
5. Factors and principal components, text analysis (3 weeks)
6. Other nonparametric methods for complex data (1 week)

## Evaluation

Your mark will be made up of assignments and one larger assignment at the end of the course, with relative weights in parentheses below. Assignments may be completed groups of up to three people. Group assignments and a description of best practices for completing assignments will be distributed when the first assignment is posted on the course website.

**Assignments (80%):** Posted over the course of the term, approximately one every two to three weeks.

**Final assignment (20%):** Final assignment, which will include an oral component during the last few weeks of class.

## Course structure and plans for a disrupted term

This course is intended to be delivered in-person. We will be using some of the video lectures that I recorded during the Winter 2020 term, in-class lectures and tutorial sessions, ideally with your computer.

- You will need to watch some video lectures before class. For some topics, the video lecture will serve as the introduction to the way that a method works, and in class we will apply those methods to new data, or get started on analyzing data to be used in an assignment.

- *I ask that if possible, you bring a laptop to class*. The best way to learn about the methods introduced in this course is by using them, and learning about the methods as a spectator is less effective. We won't use computers in each class, and I will announce what to expect a few classes ahead so that everyone knows the plan (on the first day you won't need a computer).

- The class may not go according to plan. If we are not able to meet in person, we will use the lecture slides and video lectures that were prepared for Winter 2020, and the course will proceed asynchronously. Office hours will be held synchronously at the usual time, just online.

- The final assignment should involve an oral component in the last two weeks of the course. If courses are not being held in person at that time, we will shift to an online meeting to be held at the same time as the regular class would be held.

## Other administrative details:

### Academic Integrity

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo are expected to promote honesty, trust, fairness, respect and responsibility. See the UWaterloo Academic Integrity webpage and the Arts Academic Integrity webpage for more information.

Discipline: A student is expected to know what constitutes academic integrity, to avoid committing academic offences, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 - Student Discipline. For typical penalties check Guidelines for the Assessment of Penalties.

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 - Student

Petitions and Grievances, Section 4. When in doubt, please be certain to contact the department's administrative assistant who will provide further assistance.

Appeals: A decision made or penalty imposed under Policy 70 - Student Petitions and Grievances (other than a petition) or Policy 71 - Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 - Student Appeals.

**Accommodation for Students with Disabilities**

Note for students with disabilities: The AccessAbility Services office, located on the first floor of the Needles Hall extension (1401), collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the AS office at the beginning of each academic term.

**Mental Health Support**

All of us need a support system. The faculty and staff in Arts encourage students to seek out mental health supports if they are needed.

**On Campus**

- Counselling Services: counselling.services@uwaterloo.ca / 519-888-4567 ext 32655
- MATES: one-to-one peer support program offered by Federation of Students (FEDS) and Counselling Services
- Health Services Emergency service: located across the creek form Student Life Centre

**Off campus, 24/7**

- Good2Talk: Free confidential help line for post-secondary students. Phone: 1-866-925-5454
- Grand River Hospital: Emergency care for mental health crisis. Phone: 519-749-433 ext. 6880
- Here 24/7: Mental Health and Crisis Service Team. Phone: 1-844-437-3247
- OK2BME: set of support services for lesbian, gay, bisexual, transgender or questioning teens in Waterloo. Phone: 519-884-0000 extension 213

Full details can be found online at the Faculty of ARTS website Download UWaterloo and regional mental health resources (PDF) Download the WatSafe app to your phone to quickly access mental health support information

**Territorial Acknowledgement**

We acknowledge that we live and work on the traditional territory of the Attawandaron (Neutral), Anishinaabeg and Haudenosaunee peoples. The University of Waterloo is situated on the Haldimand Tract, the land promised to the Six Nations that includes ten kilometers on each side of the Grand River.