ECO 2400 (First Half)
ECONOMETRICS I

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1. Key Course Information

Course website: Quercus (https://q.utoronto.ca)

Lectures: Monday and Wed 11:00 – 13:00 at **UC144**
Office hours: Wed 9:00-10:00, Room 236

TA: Joon Cho (joonhwan.cho@mail.utoronto.ca)

Course Delivery Method:
Lectures are delivered in person at **UC144**. However, the two first lectures will be live-streamed, not recorded. For the two first lectures, you must have access to a computer or a tablet with a working microphone and webcam, all webcams must be on.

Evaluation:
50% (This first half)
50% (Second half with Professor Yuanyuan Wan)

In this section, you will have 4 graded problem sets (20% each of them) and one midterm (20%). More detailed will be discussed in class.

2. Course Description

This course is your first step into graduate econometrics. A significant amount of time will be devoted to the question of identification (Topic 2) and causality in economics (topic 3) and we will discuss how econometricians tackle these questions. To do so, we will heavily rely on modelling uncertainty using probability theory. To have a rigorous treatment of probabilities we will start by a gentle introduction of measure theoretic foundations for probability theory (Topic 1). Once the concept of identification and causality are well established at the population level, we will ask the question on how it is possible to infer the parameter of interests when only a random sample of the population is observed (Topic 4).

In the second part of this class, Professor Wan will make a more detailed analysis of Topic 4.

Topic 1: **Gentle introduction to Measure Theory.**

Basics definitions: Sigma-Algebra, measurable space, measurable functions, measure, random variables, probability measure, etc.

Integrations and Limits Theorems: Monotone convergence, Fatou's Lemma, Dominated Convergence, Borel-cantelli lemma, etc.

References:

David Pollard: A user's Guide to Measure Theoretic Probability. Chapter 1 & 2.

Topic 2: Identification.

In this first topic, we will focus on the concept of identification which gained much wider attention in recent decades than in the past. We will discuss how data (what we observe) and model assumptions (what we assume beyond what is observed) jointly deliver answers to empirically relevant questions, highlighting both the limit/content of the data and the tradeoff between credibility of inference and strength of model assumptions. To do so, we will begin by introducing some preliminary concepts:

1. Model structures, model completeness, model coherency.
   "*…all models are wrong, but some are useful.*" – George Box.
   "*Art is not truth. Art is a lie that makes us realize truth...*" – Pablo Picasso.
2. Point/partial identification, identified set, sharp bounds.
3. Falsifiability.
   "*The criterion of the scientific status of a theory is its falsifiability, or refutability, or testability.*" – Karl Popper.

We will discuss specific applications of this general framework to, for example:

- Binary response model.
- Model of market entry.
- Endogeneity and IV models.

References:

[1] Ciliberto, F., and Tamer, E. (2009). "Market Structure and Multiple Equilibria in Airline Markets." *Econometrica*, 77(6), 1791–1828.
[2] Chesher, A., and Rosen, A. M. (2017). "Generalized Instrumental Variable Models." *Econometrica*, 85(3), 959–989.
[3] Galichon, A., and Henry, M. (2011). "Set Identification in Models with Multiple Equilibria." *The Review of Economic Studies*, 78(4), 1264–1298.
[4] Tamer (2003): "Partial Identification in Econometrics" Annual Reviews in Economics, 2, 1, 167-195.

Topic 3: Identification of Causal parameters.

In this topic, we will introduce certain notions of causality within the potential outcome framework (POM). We will discuss the challenges related to the identification of causal parameters and visit some recent methods that have been proposed to identify causal effects in some challenging environment.

1. Potential outcome models, counterfactual, causality, heterogenous treatment effects.

2. IV Estimation and the local average treatment effects (LATE).
3. The marginal treatment effect (MTE) framework.

References:

[1] Heckman, J. J., and Vytlacil, E. (2005). "Structural Equations, Treatment Effects, and Econometric Policy Evaluation." *Econometrica*, 73(3), 669–738.
[2] Imbens, G. W., and Angrist, J. D. (1994). "Identification and Estimation of Local Average Treatment Effects." *Econometrica,* 62(2), 467–475.
[3] Pearl J. and Mackenzie. D: "The Book of Why: The science of cause and effect" http://bayes.cs.ucla.edu/WHY/

Topic 4: Extremum Estimators: Consistency, Asymptotic Normality.

References:

[1] Cameron and Trivedi "Microeconometrics: Methods and applications" Chapter 5.
[2] Newey and McFadden "Large sample estimation and hypothesis testing" Handbook of Econometrics, 1994.

3. Tentative Lecture Schedule

Week	Date	Topic
1	Mon. Sep 13	Topic 1: Measure Theory
2	Wed. Sep 15	Topic 1: Measure Theory
3	Mon. Sep 20	Topic 2: Identification (1)
4	Wed. Sep 22	Topic 2: Identification (2)
5	Mon. Sep 27	Topic 2: Identification (3)
6	Wed. Sep 29	Topic 2: Identification (4)
7	Mon. Oct 4	Topic 3: Causality (1)
8	Wed. Oct 6	Topic 3: Causality (2)
9	Mon. Oct 11	Topic 3: Causality (3)
10	Wed. Oct 13	Topic 4: Extremum Estimators (1)
11	Mon. Oct 18	Topic 4: Extremum Estimators (2)
12	Wed. Oct 20	Mid-Term Exam