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Teaching statement

In this statement I discuss my teaching experience thus far, as well as some ideas for future teaching. I start with a discussion of the content of some courses that I designed and taught, and then consider pedagogical challenges and solutions that I found helpful. Syllabi and lecture slides for courses that I taught recently can be found at `https://maxkasy.github.io/home/teaching/`. An online textbook that I created for one of these courses is available at `http://inequalityresearch.net/`.

The content of courses that I taught

I have taught courses at various levels and institutions, including undergraduates at Sabanci University, UCLA, and Harvard, master students at the Institute of Advanced Studies (IHS) Vienna, and PhD students at UCLA, Harvard, University of Zurich, and University of Economics and Business (WU) Vienna. About half of these courses were core econometrics courses, which are part of the curriculum in most undergraduate and graduate economics programs. The other half were new elective courses, based on my research interests, on topics related to economic inequality, machine learning, and causality.

Core econometrics courses

The goal of the econometrics classes that I taught differs dependent on the level of the class.

- For introductory undergraduate classes, the main goal is to help students become literate consumers of quantitative research. This involves giving them a good grasp of basic notions such as causality and sampling uncertainty.
- For advanced undergraduate and core graduate classes, the goal is to help students become empirical researchers. This involves providing them with a flexible toolkit, corresponding to the standard methods that have become established in empirical economics.
- For advanced graduate classes, finally, the goal is to help students question the justification of various methods, and to develop new methods. This involves familiarizing them with state of the art research in econometrics and related fields, such as bio-statistics and machine learning.

Traditional syllabi of core econometrics classes need some updating in order to reflect these goals. Empirical practice in economics has radically changed over the last couple of decades. Questions of causality have taken center-stage, unobserved heterogeneity is taken much more seriously, and interpretations of models as literal truth have been replaced by interpretations of models as approximations.

In order to accord better with current empirical practice and student needs, I completely redesigned the content of the following econometrics courses, relative to their pre-existing versions. I believe this increased the relevance of these classes for students, as reflected in increased engagement during classes, written feedback that I regularly request of students, and

also reflected in the feedback of colleagues in applied fields who subsequently taught the same students.

Teaching required econometrics classes such as the following poses the challenge that not all students are intrinsically interested in the material covered. To address this as well as possible, I try to always anchor my lectures in a wide range of empirical applications, corresponding to various student interests, and to connect course assignments to a range of skills that subsets of students have previously acquired, such as coding, writing, and applied math, allowing them to experience success in engaging with the material. This seems to be helpful is indicated by the fact that different subgroups of students do more actively engage, and succeed, across these different assignments. Overall engagement has increased once I actively diversified the set of approaches to econometrics provided in my classes.

Microeconometric methods (1st year PhD) This course is part of the first year PhD sequence in econometrics at Harvard. It covers various topics of relevance in particular in applied microeconomics. In this course, we start by discussing identification. The focus is on settings and assumptions that allow to recover causal relationships, including randomized experiments, conditional exogeneity, IV methods, difference in differences, and regression discontinuity. We then proceed to a discussion of estimation. Statistical decision theory is introduced as a general framework to think about estimation problems and the trade-off between bias and variance. Various examples of practical relevance are covered, including machine learning methods such as Lasso, and "value added" estimation as popular in education, labor and related fields.

Applied econometrics (advanced undergraduate) This course introduces students in the "applied math and economics" major to the field of econometrics. It is effectively an honors version of the econometrics class offered to Harvard undergraduates. The goal of this class is for students to get a solid understanding of regression methods, of causality, and of (quasi-)experimental methods to estimate causal effects. The class should enable them to be critical readers of empirical research, and to begin doing their own research.

The first half of the course (parts I and II) is more mathematical, and builds on prior classes in linear algebra and analysis that the applied math students have taken, while accounting for the fact that they have less of a background in statistics. Part I is intended to give a solid understanding of the linear regression model, including panel data, and the construction of confidence intervals. The second half of the course (part III) is very applied, introducing a range of methods of causal inference based on applications from the recent empirical literature. We focus on examples from labor economics, development economics, and public finance. We discuss potential outcomes, randomized experiments, and various ways to find situations which are "like" randomized experiments.

Students have to prepare summaries of empirical papers, and present some paper. The final assignment involves replicating the main findings (tables and figures) of some paper of their choice.

Elective courses

The other half of my teaching was in elective courses. Students select into these elective courses based on interest for the topics covered, and are intrinsically motivated. This allows to be ambitious in terms of teaching goals. The goal of my elective course on "empirical research on economics inequality" is to prepare students to do their own empirical research on one of the topics covered, and most of them indeed went on to write honors theses. The goal of my elective PhD course on "advances in causality an foundations of machine learning" is to prepare students

to do their own research using advanced econometric methods, or in econometric theory itself, and all of them are in the process of doing so.

Empirical research on economic inequality (advanced undergraduate) The purpose of this class is twofold. First, to teach about economic inequality, some of its causes, and how it is affected by policy. Second, to teach econometric methods that have been used in the literature on economic inequality, in order to help prepare students to conduct their own research.

This class focuses on mechanisms affecting income inequality, such as racial discrimination, (de)unionization, minimum wages, shifts in labor demand due to changes in technology and trade, shifts in labor supply due to migration, intergenerational transmission of economic status, and taxation. In the beginning, I briefly talk about the historical evolution of income and wealth inequality, as well as about international inequality; mostly, however, the class focuses on mechanisms affecting the distribution of incomes in the United States.

I have written an open online textbook for this class, available at `http://inequalityresearch.net`. This webpage is intended to accompany the reading of the original articles assigned, as opposed to serving as a stand-alone textbook. The purpose of this webpage is to give some conceptual background and a compact overview of formal definitions and derivations and of the econometric methods used, but often left implicit, in the papers discussed.

Advances in causality and foundations of machine learning (2nd year PhD) This is a class covering some topics in econometric theory for second year PhD students. The first part of this class provides a survey of the literature on identification using instrumental variables, taking the linear model as a point of departure. The linear model imposes strong restrictions on the heterogeneity of causal effects. Generalizing this model to allow for nonlinear and heterogeneous effects leads to a variety of approaches discussed in the literature, including a re-interpretation of classic estimands as LATE, bounds on objects such as the ATE that are not point identified, conditional moment restrictions, and control function approaches.

The next part of class covers some of the theoretical foundations of machine learning, including regularization and data-driven choice of tuning parameters. We discuss in some detail the canonical normal means model. In this model, we motivate shrinkage estimators in different ways, and prove the famous result that shrinkage estimators can uniformly dominate conventional estimators. We then move from normal means to function estimation using Gaussian process priors. We show the equivalence of (empirical) Bayes estimation using such priors to penalized least squares regression with penalties corresponding to so-called reproducing kernel Hilbert space norms. The course concludes with some applications of Gaussian process priors to experimental design and to optimal taxation.

I will teach a longer version of this course in spring 2019. I plan to extend the set of topics covered by a number of additional topics from machine learning, including deep neural nets, adaptive experimental design (bandit problems and reinforcement learning), and data visualization.

Pedagogical challenges and solutions

In the following I discuss some of the challenges I encountered in teaching, and how I addressed them in my course design and teaching practice.

Learning styles, assignments, and approaches to econometrics Traditional econometrics teaching emphasizes mathematical exercises focused on some aspects of linear algebra and probability. While appealing to some subset of students, this approach is both uninteresting and difficult to many others. Different students bring different skills, interests, and learning styles.

In addition to mathematics, there are many other aspects of econometrics that one can emphasize in course assignments. This includes reading and summarizing empirical research, presenting empirical research, handling of actual data, coding and solving computational issues, replicating published research, conducting new research projects, discussing the philosophical aspects of causality, probability, and inference, etc. In my lectures, homework assignments, and exams, I try to emphasize this diversity of approaches. In my experience, such a diversified approach helps to engage a much wider set of students, in addition to covering a wider range of the skills necessary to be successful consumers and producers of empirical research.

Student diversity Economics, and even more so econometrics, has a diversity issue. Even relative to the overall population of students in the college, students from minorities and women are underrepresented in economics courses, and even more so in elective econometrics courses.

In my experience, this under-representation is at least in part due to the courses taught and the framing of course content. This was very apparent in the contrast between my econometrics course for undergraduates, relative to the class on empirical research on economic inequality. The vast majority of students in the former were male and white, while all students in the latter were members of underrepresented minorities and/or women. It should be emphasized that the latter course was not less technically demanding!

Based on this experience, I hope to teach more courses in the future which are similar to the course on economic inequality, which alternated between topics of substantive interest and methodological considerations.

Open access materials In a small effort to make research more widely accessible, I have made all my teaching slides, Syllabi and readers publicly available on my website, and have written an online open access textbook on economic inequality. I have also advertised these on social media.

This has had great success. My teaching materials on applied econometrics, on inequality, and on machine learning have been downloaded tens of thousands of times, and I regularly received emails from across the world in appreciation of these teaching materials.

Classroom interaction in lectures As more technical subject, econometrics does not lend itself easily for classroom discussions. Long lectures, however, make it hard to maintain concentration, and make it easy for students to get lost at some point in the middle.

To counteract this, I intersperse small problems for individual or group work in all my lectures, briefly interrupting the flow of class to give students time to assimilate new concepts by applying them. This serves as a break in the rhythm, allows students to self-assess whether they grasped the lecture's content, and to help each other.

The majority of students appreciates these brief exercises, though some students find the time allocated to them either too short or too long. On net, I do think they are a valuable part of my teaching, nonetheless.