

# **AEDE 8102**

## **ADVANCED APPLIED ECONOMETRICS**

***SPRING 2022***

**PROFESSOR:** Leah Bevis  
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**OFFICE:** Ag Admin 329

**LECTURE TIME:** Mon, Wed 3:00 – 4:50 PM

**LECTURE HALL:** Kottman Hall 116

**OFFICE HOURS:** Wed 12:45 – 2:45 PM (Option to join through course Zoom)

**COURSE ZOOM:** <https://osu.zoom.us/j/92757427001?pwd=ell4dmRoSkdCN2UxT0ZmN3pTVUeFkZz09>

**COURSE DESCRIPTION:** This course will provide an overview of both traditional and cutting-edge econometric tools for causal inference. We will begin with the potential outcomes framework and an overview of regression, omitted variable bias and causality. Then we'll examine the Local Average Treatment Effect (LATE) estimated by Two Stage Least Squares (2SLS). We'll move to work that evaluates the plausibility of the exclusion restriction for 2SLS, and estimation strategies that identify partial effects in situations where strict IV exogeneity does not hold. Then we'll examine statistical sensitivity tests, which bound causal treatment effects when they are not possible to estimate precisely. Then we'll explore classic quasi-experimental techniques that essentially match on observables --- matching, differences in differences, and regression discontinuity. But quasi-experimental methods are not plausible in all datasets or for all questions. In the second half of the semester we will briefly examine a series of cutting edge econometric topics: mediation analysis, dimensionality reduction in high-dimensional data settings, identification on time-varying shocks, machine learning, when to cluster standard errors, and multi-level modeling.

**COVID UPDATES:** Course attendance must generally in person, in accordance with university policy. However, exceptions are made for a number of circumstances. First, any student with an approved accommodation from Student Life Disability Services may take this course virtually. So far, no student in this class has acquired such an accommodation. Second, students who have been recently exposed to Covid or for any other reason suspect that they may have Covid should skip in-person attendance, and I will live-stream the course for that student to participate virtually.

**REQUIRED TEXTBOOK:** [AP] Angrist, Joshua and Jorn-Steffen Pischke (2009). Mostly Harmless Econometrics: An Empiricists Companion.

**SUPPLEMENTARY TEXTBOOKS:** [W1] Wooldridge, Jeffrey M. Econometric Analysis of Cross Section and Panel Data, 2nd Edition. [W2] Wooldridge, Jeffrey M. Introductory Econometrics: A Modern Approach, 6th Edition. [G] Greene, William H. Econometric Analysis 7th Edition. [HJTW] Hastie, T., James, G., Tibshirani, R., and Witten, D. An Introduction to Statistical Learning with Applications in R, New York Springer, 2013. (I do require HJTW readings, but these sections will be posted to Carmen.)

## **COURSE STRUCTURE**

Every lecture has required **reading** to be done prior to class, and some have optional readings listed too. For some topics I assign only articles, as no classic textbook chapter yet covers the topic. These articles are posted by module on Carmen. Note that I do not expect that you will always understand 100% of the assigned readings. But reading them ahead of time will help you to engage in class, ask questions, and absorb the material. To incentivize careful reading, I will frequently ask students to summarize articles or textbook chapters in class, and/or highlight questions from the reading.

In this course, I will rely on board derivations and beamer **presentations**. I will try to post weekly beamer presentations to the server every Saturday evening. It's possible that sometimes this won't happen, but most Tuesday and Thursday mornings you'll be able to examine the presentations prior to class. You may wish to print these slides and/or have them on an ipad/laptop that allows scribbling, as this will help you with note-taking. No point writing down a slew of equations that can be easily accessed via the slides.

Each of you will be assigned an OSU **server** for this class, so we don't have to worry about personal access to software. This server will hold the problem set data and some sample code in Stata and R, from lectures and labs. You can access the server from any computer through Desktop Remote Connect or Microsoft Remote Desktop — both freely available online — as long as you are online. You do need to have an internet connection to do so, however.

Each of three **problem set** asks you to work through questions regarding a particular dataset, related to (an) existing, published paper(s). Assignment data will be made available on your personal server, and both Stata and R are available on the server for analysis. I don't mind if you collaborate as you work on the problem sets — in fact, I encourage it, with the cautionary note that free riders learn less and suffer during the final replication project (and more importantly in their later research). However, you must each turn in your own, individual results/answers and the code that you used to procure those results. These answers may not be identical across students, though I realize that you'll likely give similar answers to the other people in your group. All problem set will be handed in via Carmen.

Problem sets will be given during the first half of the class, prior to spring break. The first problem set is based on the paper Grandmothers and Granddaughters, by Duflo (2003), and explores multiple strategies for procuring causal identification via OLS and 2SLS regression. **Given on Jan 12, Due Jan 27.** The second problem estimates multiple LATEs, uses non-compliers to test the exogeneity assumption, and then employs various strategies for partial identification of the LATE, using the high school dataset employed by Altonji, Elder & Taber 2005 JHR and others. **Given on Jan 31, Due Feb 15.** The third problem set explores the use of sensitivity tests to examine causal bounds around non-causal coefficients. **Given on Feb 16, Due Mar 3.** The fourth problem set explores regression discontinuity as an identification strategy, based on Alix-Garcia et al. 2013. **Given on Mar 9, Due March 30.**

If you need an **extension** for a problem set, let me know at least 3 days in advance.

Rather than a final exam, I require you to complete a **final replication project**. To do this, you must choose a paper for which the data are available. You may NOT procure the code from the author – if you do this and we catch you, you will fail the course – and the code may not be available online. You will submit the paper and the data to me by the evening of March 21<sup>st</sup>, after spring break. If it's not too simple or too complex, I'll approve it. Ideally, you should choose a paper focused on causal identification; in certain cases I may waive this restriction. Additionally, for students who really wish, I may allow you to do novel data analysis instead of a replication. **The replication is due on May 3.**

Emergencies and other extenuating circumstances affecting your ability to turn in work on time will be considered on a case-by-case basis. Overall, communication with me in advance of the due date will be rewarded, while lack of communication is likely to result in a zero.

## **EVALUATION AND PARTICIPATION**

Grades will be based primarily on the problem sets (16% each, 64% total) and your final replication (26%), but also on class participation (10%). By class participation, I mean questions, article summaries and discussion. I add in a grade for this because everyone learns econometrics better when questions, confusions and ideas are freely and openly offered. If you are a shy person, try to ask a question at least once a week. If you are a verbose person, try to ask your peers questions, or sometimes just listen and allow others a chance to speak — that's also a form of participation. I realize we are all coming from different backgrounds, and some of us may be more comfortable with open discussion than others. That's ok. Find a way to participate that feels comfortable for you, and the entire class will be better for it. And talk to me if that feels onerous. We'll find a way for you to participate comfortably.

## GENERAL SCHEDULE

The schedule below is subject to slight changes as the semester progresses.

Week	Date	Topics	Readings
<b>Potential Outcomes Framework: OLS and Causality</b>			
1-2	Jan 10	<ul style="list-style-type: none"> <li>Potential Outcome Framework</li> <li>Potential Outcomes and OLS</li> </ul>	<ul style="list-style-type: none"> <li>[AP] Chapters 1, 2, 3.1</li> </ul>
	Jan 12	<ul style="list-style-type: none"> <li>Regression and Causality</li> <li>Omitted Variables Bias</li> <li>Bad Controls</li> </ul>	<ul style="list-style-type: none"> <li>[AP] Chapter section 3.2</li> </ul>
	Jan 19	<ul style="list-style-type: none"> <li>OLS and Limited Dependent Variables</li> </ul>	<ul style="list-style-type: none"> <li>[AP] Chapter section 3.4.2</li> </ul>
		<ul style="list-style-type: none"> <li><i>Skills to Learn: Interfacing Stata and R with Latex</i></li> </ul>	<ul style="list-style-type: none"> <li>Leah's Stata-Latex materials &amp; Jiwon's R-Latex materials, found at bottom of <a href="https://leahbevis.com/teaching/">https://leahbevis.com/teaching/</a></li> </ul>
<b>Better LATE than Never?</b>			
3	Jan 24	<ul style="list-style-type: none"> <li>The LATE (2SLS)</li> </ul>	<ul style="list-style-type: none"> <li>[AP] Chapter 4.1-4.5</li> <li><u>Opt</u>: Angrist &amp; Imbens 1994 <i>Econometrica</i></li> </ul>
	Jan 26	<ul style="list-style-type: none"> <li>Forbidden Regressions</li> <li>Weak Instruments: Consequences &amp; Testing</li> </ul>	<ul style="list-style-type: none"> <li>[AP] Chapter 4.6</li> <li><u>Opt on Weak IVs</u>: Andrews, Stock &amp; Sun 2018</li> </ul>
<b>When Instrument Exogeneity (Sort of) Fails</b>			
4-5	Jan 31	<ul style="list-style-type: none"> <li>Bad IVs: Examples and Consequences</li> <li>Testing the exclusion restriction using non-compliers</li> </ul>	<ul style="list-style-type: none"> <li>Altonji, Elder &amp; Taber 2005 JHR, Angrist et al. 2010 JLE</li> <li><u>Opt</u>: Angrist, Imbens and Rubin 1996</li> <li><u>Opt on Bad IVs</u>: Bound and Jaeger 2000 RLE, Christian &amp; Barrett 2018</li> </ul>
	Feb 2, 7	<ul style="list-style-type: none"> <li>Partial identification under semi-exogenous IVs</li> </ul>	<ul style="list-style-type: none"> <li><u>Two of</u>: Conley, Hansen &amp; Rossi 2012 REStat, Nevo &amp; Rosen 2012 REStat, Kippersluis &amp; Rietveld 2018 EJ</li> </ul>
		<ul style="list-style-type: none"> <li><i>Skills to Learn: CHR, RV commands in Stata</i></li> </ul>	<ul style="list-style-type: none"> <li>Stata article on plausexog and imperfectiv</li> </ul>
<b>Sensitivity Tests (The Power of Unobservables)</b>			
5-6	Feb 9	<ul style="list-style-type: none"> <li>Quantifying the power of unobservables</li> </ul>	<ul style="list-style-type: none"> <li>Altonji, Elder &amp; Taber 2005 JPE</li> <li><u>Opt</u>: Bellows &amp; Miguel 2009, (inc. appendix), Gonzalez &amp; Miguel 2015</li> </ul>

	Feb 14, 16	<ul style="list-style-type: none"> <li>Probability of null effect</li> <li>Causal bounds</li> </ul>	<ul style="list-style-type: none"> <li>Imbens 2003, Oster 2017 JBES,</li> <li>Optional: Harada 2013, Kosec et al. (2018), Bevis et al. 2021</li> </ul>
<b>Matching on Observables (and Hopefully Unobservables)</b>			
7-9	Feb 21, 23	<ul style="list-style-type: none"> <li>Matching; Propensity scores</li> </ul>	<ul style="list-style-type: none"> <li>[AP] Chapter 3.3</li> </ul>
	Feb 28	<ul style="list-style-type: none"> <li>Fixed Effects in Panel Data</li> </ul>	<ul style="list-style-type: none"> <li>[AP] Chapter 5.1</li> <li>Opt: [AP] 5.3, 5.4</li> </ul>
	Mar 2, 7	<ul style="list-style-type: none"> <li>Differences and Differences</li> </ul>	<ul style="list-style-type: none"> <li>[AP] Chapter 5.2, TBA</li> <li>Opt: [W1] 6.5, Ravallion et al. 2005 JHR (on DDD)</li> </ul>
	March 9	<ul style="list-style-type: none"> <li>Regression Discontinuity</li> </ul>	<ul style="list-style-type: none"> <li>[AP] Chapter 6</li> <li>Opt: Alix-Garcia et al. 2013 REStat</li> </ul>
<b>Spring Break</b>			
<b>Mediation Analysis</b>			
10	March 21	<ul style="list-style-type: none"> <li>Mediation Analysis</li> <li></li> </ul>	<ul style="list-style-type: none"> <li>Acharya et al. 2016 APSR</li> <li>Opt: Imai et al. 2011 APSR</li> </ul>
	March 23	<ul style="list-style-type: none"> <li>Mediation Analysis with IV</li> </ul>	<ul style="list-style-type: none"> <li>Dippel et al. NBER</li> <li>Opt: Bevis and Villa 2020</li> </ul>
<b>Reducing Data Dimensionality</b>			
11	March 28	<ul style="list-style-type: none"> <li>Subsetting</li> <li>Regularization and Shrinkage (Ridge Regression and LASSO)</li> </ul>	<ul style="list-style-type: none"> <li>[HJTW] Chapter sections 6.1, 6.2</li> <li>Opt: Belloni, Chernozhukov &amp; Hansen 2014 JEP</li> </ul>
	March 30	<ul style="list-style-type: none"> <li>Linear combination (PCA and SVA)</li> </ul>	<ul style="list-style-type: none"> <li>[HJTW] Chapter sections 6.3</li> <li>Opt: Bai and Ng 2010, Bai and Ng 2009</li> </ul>
		<ul style="list-style-type: none"> <li><i>Skills to Learn: Subsetting, LASSO, PCA in R and Stata</i></li> </ul>	<ul style="list-style-type: none"> <li>TBA</li> </ul>
<b>What Can We Learn from the Weather?</b>			
12	April 4	<ul style="list-style-type: none"> <li>Random weather shocks</li> <li>Weather data</li> </ul>	<ul style="list-style-type: none"> <li>Dell et al. 2014 JEL, Aufhammer et al. 2013 REEP</li> </ul>
	April 6	<ul style="list-style-type: none"> <li>Common pitfalls</li> <li>Measurement error</li> </ul>	<ul style="list-style-type: none"> <li>Dell et al. 2014 JEL, Aufhammer et al. 2013 REEP</li> </ul>
		<ul style="list-style-type: none"> <li><i>Skills to Learn: Working with weather data in R</i></li> </ul>	<ul style="list-style-type: none"> <li>TBA</li> </ul>
<b>Machine Learning and Causality</b>			

13	April 11	<ul style="list-style-type: none"> <li>• Cross-validation</li> <li>• An overview of supervised and unsupervised machine learning methods</li> </ul>	<ul style="list-style-type: none"> <li>• [HJTW] Chapter 2</li> <li>• <u>One of</u>: Athey EconTalk interview, Athey and Imbens 2017 JPE "Machine Learning and Econometrics" section</li> </ul>
	April 13	<ul style="list-style-type: none"> <li>• Machine learning for heterogenous causal effects</li> </ul>	<ul style="list-style-type: none"> <li>• Athey and Imbens 2016 PNAS, TBA</li> </ul>
Clustering and Multi-Level Models			
14	April 18	<ul style="list-style-type: none"> <li>• When to cluster standard errors</li> </ul>	<ul style="list-style-type: none"> <li>• Abadie et al. 2017 NBER</li> <li>• <a href="https://blogs.worldbank.org/impactevaluations/when-should-you-cluster-standard-errors-new-wisdom-econometrics-oracle">https://blogs.worldbank.org/impactevaluations/when-should-you-cluster-standard-errors-new-wisdom-econometrics-oracle</a></li> </ul>
	April 20	<ul style="list-style-type: none"> <li>• Multi-level modeling</li> </ul>	<ul style="list-style-type: none"> <li>• TBA</li> </ul>

## INSTITUTIONAL POLICIES AND RESOURCES:

**COVID19 RESPONSE AND RESOURCES:** Please see updated information and resources related to Covid on the AEDE website. This information changes quickly. Please contact Tim Haab, Sarah Cole, me, or really any other AEDE professor with questions.

**ACADEMIC ACCESSIBILITY:** The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with [Student Life Disability Services](#). After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. **SLDS contact information:** [slds@osu.edu](mailto:slds@osu.edu); 614-292-3307; [slds.osu.edu](http://slds.osu.edu); 098 Baker Hall, 113 W. 12th Avenue.

**TITLE IX AND SEXUAL MISCONDUCT:** At Ohio State University, we strive to foster relationships based upon mutual respect, honesty, integrity, and trust. As such, we are committed to providing an educational, living, and working environment free from all forms of harassment and discrimination for all members of our community. The university prohibits all forms of sexual or gender-based discrimination, harassment or misconduct, including sexual harassment, sexual violence, relationship violence, stalking, or violations of consent.

If you or someone you know has experienced sexual misconduct, you may find information about resources and contact information OSU's [Sexual Misconduct Policy](#). For instance, on-campus confidential resources are available, including the counselors at the [Counseling and Consultation Service](#) (614-292-5766) and attorneys at [Student Legal Services](#) (614-247-5853). More information about on- and off-campus confidential resources, as well as medical treatment, law enforcement, and other support services, may be found at the [Student Advocacy Center](#).

**EMOTIONAL AND MENTAL SUPPORT:** The [Counseling and Consultation Service](#) provides support for students suffering emotionally and mentally. Any students can schedule an appointment with a counselor by calling 614-292-5766 during business hours. On most Thursdays you can also drop into "Let's Talk" for a free, informal and confidential mental health consultation called with a staff member from Counseling and Consultation Service, from 6-8 PM in the Multicultural Room at the Ohio Union. No appointment or paperwork is needed, and services are available in Mandarin Chinese, Cantonese Chinese, Korean, Hindi, and Spanish. Consultation dates are listed on the ["Let's Talk"](#) website.

**LAUREN'S PROMISE (AND MY PROMISE TO YOU):** I will listen and believe you if someone is threatening you, and I will help you find help – immediately.

Lauren McClusky, a 21-year-old honors student athlete, was murdered on October 22, 2018 by a man she briefly dated on the University of Utah campus. We must all take actions to ensure this never happens again.

If you are in immediate danger call 911. Do not hesitate.

If you experiencing sexual assault, domestic violence, or stalking please seek help from the police whether or not you are in immediate danger.

- Campus police: (614) 292-2121 (for things that happen on campus)
- Columbus Police: (614) 645-4545 (for things that happen off campus)

You can also seek help specific to sexual or domestic violence from (24/7):

- Sexual Assault Response Network of Central Ohio (SARNCO) Rape Helpline: 614-267-7020
- Rape, Abuse and Incest National Network Sexual Assault Hotline: 800-656-4673

- Lutheran Social Services Choices Domestic Violence Hotline: 614-224-4663
- LGBT National Health Center Hotline: 888-843-4564

Medical providers can conduct forensic evaluations within 120 hours of an assault

- Wexner Medical Center: 614-293-8333
- Wilce Student Health Center: 614-292-4321

Confidential support services:

- Sexual Assault Response Network of Central Ohio (SARNCO), on campus: 614-688-2518
- Counseling and Consultation Services: After-hours helpline: 614-292-5766, choose option 2
- Stress, Trauma and Resilience (STAR) Trauma Recovery Center: 614-293-7827