

**Econ 481-3**  
**Topics in Econometrics**  
**Spring 2024**

**Lecture:** TTh 9:00-10:50 am in KGH 3301 ☺

**Instructor:** Ivan Canay

Office: 3353 KGH  
Phone: 847-491-2929  
Email: [iacanay@northwestern.edu](mailto:iacanay@northwestern.edu)  
Web Page: <http://sites.northwestern.edu/iac879>  
Office Hours: by appointment (see appointment link in Canvas)

**Course Description:** This course is the third quarter in the graduate econometrics sequence. It is divided in three parts. Part I presents a comprehensive discussion of the most popular instrumental variables approaches for causal inference currently used in applied work. Part II presents what I consider to be the fundamental notions behind asymptotic approximations, with a discussion of uniform inference that will conclude with inference in moment inequality models. Part III covers recent developments in the literature on difference in differences.

**Grading:** Grading will consist on weekly reports (submitted via Canvas), two problem sets due on **April 30th** and **May 16th**, and an in-class presentation on one of the topics of Part III. The problem sets will be available a week and a half before the due date and will consist of theoretical questions and empirical/methodological questions. Weekly reports should avoid displays and formulas and be limited to a maximum of two pages. Finally, for the in-class presentation the students must prepare a slide presentation and write a 8-10 pages long set of lecture notes as described below. The weighting scheme for the final grade will be:

Weekly Reports:	20%
Problem sets:	50%
in-Class presentation:	30%

**Lecture Notes:** I will provide lecture notes or slides every week with related references you are supposed to read. The readings listed below include most of the articles we will discuss in class.

**in-class Presentation:** Students should split into **4 groups** and choose one of the topics of Part III by **April 18th**. The following is expected:

- **Day of presentation:** A slide presentation available to students the morning before class.
- **Day of presentation:** A set of lecture notes that is about 8-10 pages long in a similar format than the one used for the class lecture notes. I expect minimal copy-pasting from the original sources.
- **Grading the day after:** Grading will evaluate the clarity of the slides, the clarity of the lecture note, and the quality of the exposition during the presentation. This part of the course will involve anonymous **peer grading**, so each student will have to fill out the grading form (rubric) after each presentation in Canvas.

**AccessibleNU:** Any student requesting accommodations related to a disability or other condition is required to register with AccessibleNU (847-467-5530) and provide professors with an accommodation notification from AccessibleNU, preferably within the first two weeks of class. All information will remain confidential.

**Lecture Recordings:** Unauthorized student recording of classroom or other academic activities (including advising sessions or office hours) is prohibited. Unauthorized recording is unethical and may also be a violation of University policy and state law. Students requesting the use of assistive technology as an accommodation should contact AccessibleNU. Unauthorized use of classroom recordings — including distributing or posting them — is also prohibited. Under the University’s Copyright Policy, faculty own the copyright to instructional materials — including those resources created specifically for the purposes of instruction, such as syllabi, lectures and lecture notes, and presentations. Students cannot copy, reproduce, display or distribute these materials. Students who engage in unauthorized recording, unauthorized use of a recording or unauthorized distribution of instructional materials will be referred to the appropriate University office for follow-up.

**Discord Channel:** Join me and current econometric students on Discord. Discord is a free communications app that lets you share voice and text chat with friends and communities. Participation in Discord is not required and it is intended as another layer of support. Instructions on how to join are available on Canvas.

**YouTube Channel:** The video recordings from the Spring 2021 quarter are freely available on YouTube. Lectures 5 and 6 are, however, not available as these are new topics. When available, you may find those videos a good source of supporting material. More information available on Canvas.

**Attendance:** Attendance is not mandatory but it honestly does not make a lot of sense that you take this class if you do not plan to attend. If you cannot attend lectures, I recommend you take some other class this quarter.

## Tentative Course Schedule: Econ 481-3 Spring 2024

Lecture	Date	Topics	Evaluation
<b>Part I:</b>			
<b>A Primer on Causal Inference</b>			
1	Th, March 28	Selection on Observables	–
2	Tu, April 2	Roy Models and LATE	–
3	Th, April 4	Marginal Treatment Effects (MTEs)	–
4	Tu, April 9	Extrapolation and Some Extensions	–
5	Th, April 11	Augmented IPW	PS1 out
6	Tu, April 16	Double Robustness and Cross Fitting*	–
<b>Part II:</b>			
<b>Understanding Asymptotic Approximations</b>			
7	Th, April 18	Local Asymptotics	Pick Topic
8	Tu, April 23	Contiguity	–
9	Th, April 25	Local Asymptotic Normality	–
10	Tu, April 30	Convolution Theorems	PS1 due
11	Th, May 2	The Bahadur-Savage Problem	PS2 out
12	Tu, May 7	Uniformity of the $t$ -test	–
13	Th, May 9	Inference in Moment Inequality Models I	–
14	Tu, May 14	Inference in Moment Inequality Models II	–
<b>Part III*:</b>			
<b>Differences in Differences</b>			
15	Th, May 16	Ch 1 - Ch 3 of [21] & [39, 20]	Presentation — PS2 due
16	Tu, May 21	Ch 4 - Ch 5 of [21] & [38][33][28]	Presentation
17	Th, May 23	Ch 6 of [21] & [14][19]	Presentation
18	Tu, May 28	Ch 7 of [21] & +	Presentation
19	Th, May 30	Feedback on reports	

## Readings

- [1] ANDREWS, D. W. K. Inconsistency of the bootstrap when a parameter is on the boundary of the parameter space. *Econometrica* 68, 2 (March 2000), 399–405.
- [2] ANDREWS, D. W. K., AND GUGGENBERGER, P. Hybrid and size-corrected subsample methods. *Econometrica* 77, 3 (May 2009), 721–762.
- [3] ANDREWS, D. W. K., AND GUGGENBERGER, P. Validity of subsampling and “plug-in asymptotic” inference for parameters defined by moment inequalities. *Econometric Theory* 25, 3 (June 2009), 669–709.
- [4] ANDREWS, D. W. K., AND SOARES, G. Inference for parameters defined by moment inequalities using generalized moment selection. *Econometrica* 78, 1 (January 2010), 119–158.

- [5] ANGRIST, J., AND EVANS, W. N. Children and their parents' labor supply: Evidence from exogenous variation in family size, 1996.
- [6] ARKHANGELSKY, D., ATHEY, S., HIRSHBERG, D. A., IMBENS, G. W., AND WAGER, S. Synthetic difference-in-differences. *American Economic Review* 111, 12 (2021), 4088–4118.
- [7] ATHEY, S., AND IMBENS, G. W. Design-based analysis in difference-in-differences settings with staggered adoption. *Journal of Econometrics* 226, 1 (2022), 62–79.
- [8] BAHADUR, R., AND SAVAGE, L. J. The nonexistence of certain statistical procedures in nonparametric problems. *Annals of Mathematical Statistics* 25 (1956), 1115–1122.
- [9] BILLINGSLEY, P. *Probability and Measure*. Wiley-Interscience, 1995.
- [10] BRINCH, C. N., MOGSTAD, M., AND WISWALL, M. Beyond late with a discrete instrument. *Journal of Political Economy* 125, 4 (2017), 985–1039.
- [11] BUGNI, F., CANAY, I. A., AND SHI, X. Inference for subvectors and other functions of partially identified parameters in moment inequality models. *Quantitative Economics* 8, 1 (2017), 1–38.
- [12] BUGNI, F. A. Bootstrap inference in partially identified models defined by moment inequalities: Coverage of the identified set. *Econometrica* 78, 2 (April 2010), 735–753.
- [13] BUGNI, F. A., CANAY, I. A., AND GUGGENBERGER, P. Distortions of asymptotic confidence size in locally misspecified moment inequality models. *Econometrica* 80, 4 (2012), 1741–1768.
- [14] CALLAWAY, B., AND SANT'ANNA, P. H. Difference-in-differences with multiple time periods. *Journal of Econometrics* 225, 2 (2021), 200–230.
- [15] CANAY, I. A. El inference for partially identified models: Large deviations optimality and bootstrap validity. *Journal of Econometrics* 156, 2 (June 2010), 408–425.
- [16] CANAY, I. A., SANTOS, A., AND SHAIKH, A. M. On the testability of identification in some nonparametric models with endogeneity. *Econometrica* 81, 6 (2013), 2535 – 2559.
- [17] CANAY, I. A., AND SHAIKH, A. M. Practical and theoretical advances for inference in partially identified models. In *Advances in Economics and Econometrics: Volume 2: Eleventh World Congress*, B. Honoré, A. Pakes, M. Piazzesi, and L. Samuelson, Eds., vol. 2. Cambridge University Press, 2017, pp. 271–306.
- [18] CARNEIRO, P., HECKMAN, J. J., AND VYTLACIL, E. J. Estimating marginal returns to education. *American Economic Review* 101, 6 (2011), 2754–81.

- [19] DE CHAISEMARTIN, C., AND D’HAULTFOEUILLE, X. Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review* 110, 9 (2020), 2964–96.
- [20] DE CHAISEMARTIN, C., AND D’HAULTFOEUILLE, X. Two-way fixed effects and differences-in-differences with heterogeneous treatment effects: A survey. Tech. rep., National Bureau of Economic Research, 2022.
- [21] DE CHAISEMARTIN, C., AND D’HAULTFOEUILLE, X. Difference-in-differences for simple and complex natural experiments. Available at SSRN: <https://ssrn.com/abstract=4487202> or <http://dx.doi.org/10.2139/ssrn.4487202>.
- [22] GOODMAN-BACON, A. Difference-in-differences with variation in treatment timing. *Journal of Econometrics* 225, 2 (2021), 254–277.
- [23] HECKMAN, J. J., AND VYTLACIL, E. Structural equations, treatment effects, and econometric policy evaluation 1. *Econometrica* 73, 3 (2005), 669–738.
- [24] HOEFFDING, W. The large-sample power of tests based on permutations of observations. *The Annals of Mathematical Statistics* 23, 2 (1952), pp. 169–192.
- [25] IMBENS, G. W. Nonparametric estimation of average treatment effects under exogeneity: A review. *Review of Economics and statistics* 86, 1 (2004), 4–29.
- [26] IMBENS, G. W., AND ANGRIST, J. D. Identification and estimation of local average treatment effects. *Econometrica* 62, 2 (1994), 467–475.
- [27] LEHMANN, E., AND ROMANO, J. P. *Testing Statistical Hypotheses*, 3rd ed. Springer, New York, 2005.
- [28] MANSKI, C. F., AND PEPPER, J. V. How do right-to-carry laws affect crime rates? coping with ambiguity using bounded-variation assumptions. *Review of Economics and Statistics* 100, 2 (2018), 232–244.
- [29] MOGSTAD, M., SANTOS, A., AND TORGOVITSKY, A. Using instrumental variables for inference about policy relevant treatment parameters. *Econometrica* 86, 5 (2018), 1589–1619.
- [30] NELSON, F., AND SAVIN, N. The danger of extrapolating asymptotic local power. *Econometrica* 58, 4 (1990), 977–981.
- [31] POLITIS, D. N., ROMANO, J. P., AND WOLF, M. *Subsampling*. Springer, New York, 1999.
- [32] POLLARD, D. *A User’s Guide to Measure Theoretic Probability*. Cambridge University Press, New York, 2002.

- [33] RAMBACHAN, A., AND ROTH, J. An honest approach to parallel trends. *Unpublished manuscript, Harvard University* (2022).
- [34] ROMANO, J. P. On non-parametric testing, the uniform behaviour of the t-test, and related problems. *Scandinavian Journal of Statistics* 31 (2004), 567–584.
- [35] ROMANO, J. P., AND SHAIKH, A. M. On the uniform asymptotic validity of subsampling and the bootstrap. *The Annals of Statistics* 40, 6 (2012), 2798–2822.
- [36] ROMANO, J. P., SHAIKH, A. M., AND WOLF, M. A practical two-step method for testing moment inequalities. *Econometrica* 82, 5 (2014), 1979–2002.
- [37] ROSENBAUM, P. R., AND RUBIN, D. B. The central role of the propensity score in observational studies for causal effects. *Biometrika* 70, 1 (1983), 41–55.
- [38] ROTH, J. Pre-test with caution: Event-study estimates after testing for parallel trends. *American Economic Review: Insights (forthcoming)* (2022).
- [39] ROTH, J., SANT’ANNA, P. H., BILINSKI, A., AND POE, J. What’s trending in difference-in-differences? a synthesis of the recent econometrics literature. *arXiv preprint arXiv:2201.01194* (2022).
- [40] SAVIN, N. E., AND WÜRTZ, A. H. Power of tests in binary response models. *Econometrica* 67, 2 (1999), pp. 413–421.
- [41] SERFLING, R. J. *Approximation Theorems of Mathematical Statistics*. John Wiley, New York, 1980.
- [42] SUN, L., AND ABRAHAM, S. Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics* 225, 2 (2021), 175–199.
- [43] VAN DER VAART, A. W. *Asymptotic Statistics*. Cambridge University Press, Cambridge, 1998.
- [44] VYTLACIL, E. Independence, monotonicity, and latent index models: An equivalence result. *Econometrica* 70, 1 (2002), 331–341.