Hessian LLC | September 13-September 24, 2021 | 10:00am-3:00pm Eastern Standard Time

Modern Difference in Difference Designs

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Course Description

Difference in Difference designs are one of the most versatile and powerful tools for observational causal inference in use today. In the last few years, we have seen a veritable explosion of work on DiD methods that has made it very difficult to keep track of rapidly changing standards. This ten-day workshop will begin with the basic DiD design using two-way fixed effects and build up to the state-of-the-art applications. We will then move into advanced extensions like matching, synthetic control, asymmetric/staggered treatments, dynamic treatments, interference, and heterogeneous treatment effects. We will work though DiD designs with practical examples, assumptions, diagnostics, and code in R and Stata (when available).

This workshop is appropriate for anyone considering using observational causal inference tools and makes no assumption of pre-existing training beyond basic regression.

Schedule

Each day will follow the same three block format. Most days this will include 1) a broad overview of a problem & the associated literature 2) an in-depth look at a particularly important paper that you need to understand well and 3) how to implement these methods in software.

References associated with each block are listed below their time slot. Some of these papers are only very loosely related to the topic. You do not have to have read these articles before their lecture.

We will have two 30 minute breaks at 11:15 & 1:00 EST.

Monday: Introduction to DiD

10:00-11:15 Basic Difference in Difference

Wing, C., et al. (2018). "Designing Difference in Difference Studies: Best Practices for Public Health Policy Research." Annual Review of Public Health 39: 453-469.

Kahn-Lang, A., & Lang, K. (2019). The promise and pitfalls of differences-in-differences: Reflections on 16 and pregnant and other applications. Journal of Business & Economic Statistics, 1-14.

11:45-1:00 Making Sense of the DiD Literature

Almost all work in the extended universe of DiD and DiD-like methods are concerned with one or more of the following questions:

1) Are treatment & control groups comparable?
2) How are the treatments structured?
3) Is there heterogeneity in treatment effects?
4) Are there issues of spillover, interference, or non-compliance?

1:30-3:00 DiD in R & Stata

We will be working to make sure that people have access to both R and Stata and can use the appropriate packages in either. If you are familiar with both programs (and both work on your machine) then you may decide to skip this lab and work through the material yourself.

Prior to the lab, please have the programs installed on your machine. You can find the current version of R as well as a trial copy of Stata 17 in the Software folder in the Course Dropbox Files.

Tuesday: Thinking Through Data Structures

The purpose of today's lectures is to provide an overarching framework for how to think about problems in DiD that typically manefest themselves as effect heterogeneity. We will be going through a general road map to be able to handle any kind of DiD-like problem without getting lost no matter how complex it might appear. This road map will be reinforced each day in the class so that by the end you know how to break down even the most complicated DiD problems into a workable plan.

10:00-11:15 Thinking Through The Sources of Heterogeneity

No specific readings as we will be touching on some very abstract topics and going through a checklist

11:45-1:00 Thinking Through Treatment Structures

De Chaisemartin, C., & d'Haultfoeuille, X. (2018). Fuzzy differences-in-differences. The Review of Economic Studies, 85(2), 999-1028.

Yamauchi, S. (2020). Difference-in-Differences for Ordinal Outcomes: Application to the Effect of Mass Shootings on Attitudes toward Gun Control. Working Paper

1:30-3:00 Thinking Through Grouping Structures

Olden, A. Møen, J. 2020 The triple difference estimator. NHH Dept. of Business and Management Science Discussion Paper

Goodman-Bacon, A., 2018. Difference-in-differences with variation in treatment timing (No. w25018). National Bureau of Economic Research.

Wednesday: Group Comparability

Note that today only really has two lectures. The first is on how to evaluate parallel trends and other related assumptions. The other is about techniques that you can use when you might not want to make unconditional parallel trends assumptions. We will still have two breaks at about the same time as normal.

10:00-11:15 A Macroscopic View of Parallel Trends

The parallel trends assumption is fundamentally concerned with treatment & control group comparability. We discuss how the parallel trends assumption relates to other possible assumptions and how we can evaluate them all.

Sofer, T., Richardson, D. B., Colicino, E., Schwartz, J., & Tchetgen, E. J. T. (2016). On Negative Outcome Control of Unobserved Confounding as a Generalization of Difference-in-Differences. Statistical science, 31(3), 348-361.

Keele, L. J., Small, D. S., Hsu, J. Y., & Fogarty, C. B. (2019). Patterns of Effects and Sensitivity Analysis for Differences-in-Differences.

Rambachan, A. & Roth, J., (2019). An honest approach to parallel trends. Working Paper.

Bilinski, A., & Hatfield, L. A. (2018). Nothing to see here? Non-inferiority approaches to parallel trends and other model assumptions. arXiv preprint

Mora Villarrubia, R., & Reggio, I. (2012). Treatment effect identification using alternative parallel assumptions. Universidad Carlos III de Madrid. Departamento de Economía.

Freyaldenhoven, S., Hansen, C., & Shapiro, J. M. (2019). Pre-event trends in the panel event-study design. American Economic Review, 109(9), 3307-38.

Egami, N., & Yamauchi, S. (2019). How to improve the difference-in-differences design with multiple pre-treatment periods. Working Paper

Leavitt, T. (2020). Beyond Parallel Trends: Improvements on Estimation and Inference in the Difference-in-Differences Design. Working paper.

Roth, J. (2018). Should we adjust for the test for pre-trends in difference-in-difference designs?. Working Paper

11:45-1:00 A Macroscopic View of Propensity Score Theory in DiD

Stuart, et al (2014). Using propensity scores in difference-in-differences models to estimate the effects of a policy change. Health Services Outcomes Research Methodology, 14(4), 166-182.

Daw, J. R. and L. A. Hatfield (2018). Matching in Difference-in-Differences: between a Rock and a Hard Place, Health Research & Educational Trust.

Lindner, S. and K. J. McConnell (2019). "Difference-in-differences and matching on out-

comes: a tale of two unobservables." Health Services and Outcomes Research Methodology 19(2-3): 127-144.

Daw, J. R. and L. A. Hatfield (2018). "Matching and Regression to the Mean in Difference-in-Differences Analysis." Health Serv Res 53(6): 4138-4156.

Sant'Anna, P. H., & Zhao, J. B. (2020). Doubly robust difference-in-differences estimators. Forthcoming at the Journal of Econometrics

Ben-Michael, E., Feller, A. and Rothstein, J., (2018). The augmented synthetic control method.

Thursday: Full Lab Day

Today will just be going through lab content in both Stata and R. Exact content will depend on student interest but will include the following at minimum:

1) Diagnostics for parallel trends and alternative assumptions in R and Stata
2) Weighting methods for IPW, synthetic control, and some advanced alternatives
3) Tools for staggered timing (Goodman-Bacon and Callaway & Sant'Anna in particular)
4) Some advanced techniques for generalized counterfactual estimation

Friday & Monday: Project Consultations

No formal lectures today.

Participants will schedule individual meetings with the instructors to discuss their research. Students with similar research agendas may be grouped together to facilitate collaboration.

You will be asked to fill out a brief questionnaire about your research by Thursday morning to allow us to prepare for the meeting.

Tuesday: Differential Timing

We will be discussing staggered or differential timing problems and the current state of the art solutions. It should be noted that we will be covering this problem in most of the lectures in the first week as well as the lab day as a special case of broader problems (e.g. effect heterogeneity & group comparability). However, we will be breaking them down into a lot of detail today as this is easily one of the most common problems applied researchers will face.

10:00-11:15 A Macroscopic View of Staggered Adoption Problems

Goodman-Bacon, A., 2018. Difference-in-differences with variation in treatment timing (No. w25018). National Bureau of Economic Research.

Abraham, S., & Sun, L. (2018). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects.

Callaway, B. and P. H. Sant'Anna (2019). "Difference-in-differences with multiple time periods."

Ben-Michael, E., Feller, A., & Rothstein, J. (2019). Synthetic controls and weighted event studies with staggered adoption.

Athey, S., & Imbens, G. W. (2018). Design-based analysis in difference-in-differences settings with staggered adoption.

de Chaisemartin, C., & D'Haultfœuille, X. (2020). Difference-in-Differences Estimators of Intertemporal Treatment Effects. arXiv preprint arXiv:2007.04267.

11:45-1:00 An In-Depth Look at Goodman-Bacon (2018) and Callaway & Sant'Anna (2019)

1:30-3:00 The bacon and did packages

Wednesday: Interference, Spillover, & Noncompliance

10:00-11:15 A Macroscopic View of Interference

Bowers, J., Fredrickson, M. M., & Panagopoulos, C. (2013). Reasoning about interference between units: A general framework. Political Analysis, 21(1), 97-124.

Delgado, M. S., & Florax, R. J. (2015). Difference-in-differences techniques for spatial data: Local autocorrelation and spatial interaction. Economics Letters, 137, 123-126.

De Castris, M., & Pellegrini, G. (2015). Neighborhood effects on the propensity score matching (No. 0515).

Aronow, P. M., Eckles, D., Samii, C., & Zonszein, S. (2021). Spillover effects in experimental data. arXiv preprint arXiv:2001.05444.

Ogburn, E. L., & VanderWeele, T. J. (2014). Causal diagrams for interference. Statistical science, 29(4), 559-578.

Berg, T., & Streitz, D. (2019). Handling Spillover Effects in Empirical Research. Available at SSRN 3377457.

Clarke, D. (2017). Estimating Difference-in-Differences in the Presence of Spillovers.

Egami, N. (2021) Spillover Effects in the Presence of Unobserved Networks. Political Analysis

Harris, R.; Moffat, J. Kravtsova, V. (2011) In search of 'W'. Spatial Economic Analysis

11:45-1:00 In-Depth Look at Bowers (2013), Aronow (2021), & Harris (2011)

1:30-3:00 Spatial and Network weights in Stata & R.

We will discuss spatial weights for contiguity and distance matrices and how to use them in the spatial suite in Stata. We will also look at the interference package in R and work through what exactly a latent variable weights matrix looks like and does.

Thursday: Generalized Counterfactual Estimators

10:00-11:15 Building a Theory of Counterfactual Estimators

Liu, L., Wang, Y., & Xu, Y. (2020). A practical guide to counterfactual estimators for causal inference with time-series cross-sectional data.

Ferman, B., Pinto, C. (2019). Synthetic controls with imperfect pre-treatment fit. Working Paper

Ben-Michael, E., Feller, A. and Rothstein, J., 2018. The augmented synthetic control method.

Doudchenko, N., & Imbens, G. W. (2016). Balancing, regression, difference-in-differences and synthetic control methods: A synthesis.

Arkhangelsky, D., Athey, S., Hirshberg, D. A., Imbens, G. W., & Wager, S. (2019). Synthetic difference in differences (No. w25532). National Bureau of Economic Research. par

Kropko, J., & Kubinec, R. (2018). Why the two-way fixed effects model is difficult to interpret, and what to do about it.

Gobillon, L., & Magnac, T. (2016). Regional policy evaluation: Interactive fixed effects and synthetic controls. Review of Economics and Statistics, 98(3), 535-551.

Xu, Y., 2017. Generalized synthetic control method: Causal inference with interactive fixed effects models. Political Analysis, 25(1), pp.57-76.

Athey, S., Bayati, M., Doudchenko, N., Imbens, G., & Khosravi, K. (2018). Matrix completion methods for causal panel data models.

Stewart (2014) Latent factor regressions for the social sciences. Unpublished

de Chaisemartin, C., & d'Haultfoeuille, X. (2019). Two-way fixed effects estimators with heterogeneous treatment effects (No. w25904). National Bureau of Economic Research.

Bonhomme, S., & Sauder, U. (2011). Recovering distributions in difference-in-differences models: A comparison of selective and comprehensive schooling. Review of Economics and Statistics, 93(2), 479-494.

Rhodes, W. (2010). Heterogeneous treatment effects: what does a regression estimate? Eval Rev, 34(4), 334-361.

Glynn and Ichino, 2019 "Generalized nonlinear difference-in-difference-in-differences," V-Dem Working Paper

11:45-1:00 An In-Depth Look at Liu, Wang, and Xu (2020)

1:30-3:00 Using the FECT package in Stata & R

Friday: Review

We will set up a review day based on what people would like more time on.