

**Causal Inference in Education Policy Research  
EDLF 5500, Spring 2011**

**DRAFT**

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Thurs. 9-11 or by appointment

**Overview**

Many of the most pressing questions in education are, at their core, about understanding causal relationships. Does attending a high-quality pre-school program cause children to do better in elementary school? Does attending a charter school lead students to achieve at higher rates? What is the effect of being in a small class? Does having a teacher with a Masters degree cause students to learn more in high school science classes? What is the impact of attending a 4-year rather than 2-year college on earnings?

Policymakers are eager to find reliable evidence on these and other questions so they can implement effective policies and make choices between policy alternatives. Unfortunately, much of the research currently available does not provide this type of evidence. Many education studies in the social sciences will show that students who experienced a particular intervention outperformed students who had a different experience. These findings may highlight important relationships (associations, correlations, etc.), however they do not demonstrate that the intervention itself *caused* the difference in the outcomes. The key problem is non-random selection. Perhaps the children who received the intervention are systematically different from those who did not. Perhaps they would have done comparatively better irrespective of the intervention.

This course introduces students to a set of *quasi-experimental* approaches for estimating the causal impact of education interventions and policies. Methods include: propensity score matching, difference-in-difference estimators, instrumental variables, regression discontinuity, fixed effects estimators and value-added modeling. Students will learn how to apply these analytic strategies to policy questions and will examine how these methods compare to experimental designs. The course will also teach students to critically evaluate quantitative research that claims to identify causal impacts of educational interventions.

**Course organization**

Typically we will use the first portion of the class for a discussion of the week's assigned readings. The second portion of the class I will introduce new material. I am hoping this will give us a good opportunity to explore these issues in some depth. I am happy to tailor portions of the class to students' particular research interests, and have left some time at the end of the semester to explore causal literature in policy areas of particular interest to the class members.

**Pre-requisites**

Students in this course should have completed an introductory course in multiple regression analysis (e.g. EDLF 8310).

**Course Requirements:**

The course requirements include class participation and paper presentations (35 percent), a referee report (20 percent) and a final project (45 percent)

**Class Participation & Presentations (35 % of final grade):**

My expectation is that students do all required readings for this class carefully and in advance of the assigned class. Students are expected to come to class ready to discuss the material thoughtfully. *You really need to do the readings in this class to learn the material.* Most weeks one of the assigned readings will have a (P) in front of it. The (P) indicates you must be prepared to provide a brief (~10 minute) overview of the paper in class and to lead a discussion with your classmates. Your presentation should include the following elements, which you should consider when reading any of the empirical papers assigned for this class:

<b>Presentation Component</b>	<b>Description</b>
Broad research question	Does merit pay improve teacher performance?
Specific research question	What is the effect of state X's merit pay system on high-school student's mathematics assessment scores?
Causal Inference challenge	Why is it difficult to get at the broad research question? What are the possible selection issues and how might they bias the results
Population of interest (POI)	For which population would we like to answer this question?
Population of the sample (POS)	Who is in the actual data? i.e. grade, year, location, etc.
Population of causal inference (POCI)	Which part of the POS can we generalize the results to?
Methodological Approach	What did the authors do? What was their identification strategy?
Assumptions	What assumptions do the authors make? Are they plausible? How might they be violated?
Findings/Implications	What can the study tell us?
Limitations	What would the study like to tell us that it cannot?
Other thoughts? Comments/Questions	Any issues you'd like to discuss further as a class? Issues you did not understand.

Please prepare your presentation using power point (Note: The presentation need not be particularly aesthetically pleasing. Focus on clarity & brevity. A few slides should do it). You may bring your presentation on a pen drive or email it to me prior to class. I will randomly select one student to lead the discussion each week.

**Referee Reports (20 % of final grade):** Each student will write a referee report reviewing an unpublished, empirical paper that employs methods discussed in this class. The review (**due March 22**) should address a paper that employs a difference-in-difference strategy, uses a lottery as a source of randomization, uses instrumental variables or employs a regression discontinuity design.

Your job is to imagine the paper has been sent to a top education journal (i.e. American Educational Research Journal, Educational Evaluation and Policy Analysis). The editor has asked that you review the paper. Provide a brief (approximately 3-5 page, single-space) review of each paper. Focus your review on the concepts from this class (i.e. defining the research question, appropriateness of the data utilized, plausibility of assumptions, internal/external validity, interpretations, etc.). Note: While it is fine to comment on the substantive contribution of the paper to the field, this is not essential for this assignment. I will provide additional guidelines about the format and content of the referee review in class.

I will suggest several possible papers to review. Alternatively, students may choose any relatively new (post-2000) working paper, pending my approval. Two good sources for such working papers are: Social Science Research Network (<http://www.ssrn.com/>) and the National Bureau for Economic Research (<http://www.nber.org/papers.html>).

### **Final Paper (45 % of Final Grade):**

The final paper for this course should focus on a research question that can be addressed through quasi-experimental methods. Note that while we'll be discussing randomized experiments as a starting point, the focus of this class will be quasi-experimental approaches to causal inferences, so any research proposal must involve at least one of these methods.

The paper may take a variety of forms depending of student's interests and abilities, although I expect most students to choose option 1:

- 1) A critical review of the literature in a specific field focusing particularly on the literature's strengths and weaknesses regarding causal inference. This review should identify a specific causal question and then review the literature (in whatever fields are relevant) that attempts to answer this question. Depth, detail, and critical reading are valued here over breadth and vague generalities.
- 2) A proposal for a research study that uses one or more of the quasi-experimental methods discussed in the course. This proposal should be detailed in specifying the source(s) of data and the analytic strategies to be used. This proposal could be the research design and analysis of a dissertation proposal, for example.
- 3) A data analysis paper that uses one or more of the methods discussed in the course to analyze extant data to make valid causal inference. Such a paper would include careful description of the rationale for and methods of analysis used, and a discussion of the assumptions made as well as interpretation of the results. *(If you are intending to pursue this option, I'd urge you to come talk to me during office hours ASAP.)*

### **Paper Deadlines:**

1. Paper proposal (5 %): **Due Feb. 22:** 1-2 page proposal for your final paper. At minimum this should include your research question, approach (literature review? paper proposal?), a brief overview of existing literature, and any questions you have for me about the project.
2. Progress Report/Draft: **Optional due April 5<sup>th</sup>** via email. I am happy to read and provide feedback on drafts submitted at or before this date. **While this is optional, I strongly urge all students to take me up on this. (5 points extra credit)**

3. Presentation (10 %): **April 26<sup>th</sup>** or **May 3<sup>rd</sup>** In class presentation on final paper
4. Final Paper (30%): Due 5 pm, **May 6<sup>th</sup>**, via email.

### **Academic Integrity**

I assume and expect that all students will approach the work they do both in this class and outside of it, with academic honesty. It is the student's responsibility to become familiar with and adhere to the guidelines outlined in the University of Virginia Honor Code. See also:  
<http://www.virginia.edu/honor/proc/fraud.html>

The writing assignments you submit must reflect your own independent thinking. This means that all passages that are verbatim quotes from other sources must be enclosed in quotation marks. It also means that other material that is paraphrased must be properly attributed. If you are ever unsure about appropriate citation norms, I expect you to take the time to find out and I welcome you to see me if you are unsure. UVA provides some very helpful examples and guidelines on these issues here: [www.virginia.edu/honor/documents/PlagiarismSupplement.doc](http://www.virginia.edu/honor/documents/PlagiarismSupplement.doc)

Also note, if an assignment in this class meets the requirements for another current *or previous* class and you intend to submit the same paper to meet both requirements, standards of academic honesty require that you inform all involved instructors and get approval well in advance of the relevant deadlines.

### **Books & Readings**

Most of the readings for this class will be posted on the class COLLAB website. Though there is not a single comprehensive text that covers all the material in this class, I am requiring one book which provides a terrific overview of much of the material. A copy is available at the library and it is available for purchase through Amazon.com:

**Murnane, R & Willett, J. (2011) *Methods Matter: Improving Causal Inference in Educational and Social Science Research*. Oxford University Press.**

The reading list includes supplementary readings. These papers are **OPTIONAL**. They provide additional applied examples, practical advice, and more advanced technical resources. I've listed them to provide further material for students who wish to pursue these topics in greater depth.

### **A note on auditing**

Several students have contacted me about auditing this course. I am all for this, but there is a price for admission. All auditing students should participate in class discussions, and to do so, they must also read all assigned readings for the week. You will not get much out of this class if you do not do the hard work of working through the empirical papers we are reading. I will be calling on all students (enrolled and auditors) to answer questions and contribute.

Auditors are not required to submit the written assignments for this course. That said, if you would like to submit any of the assignments, I will grade them and give you the same level of feedback as I do any of the enrolled students.

## Class Schedule

Date	Lecture Topic	Assignment Due
January 25	<ul style="list-style-type: none"> <li>▪ Class overview</li> <li>▪ Rubin Causal Model, The Logic of the Counterfactual</li> </ul>	
February 1	<ul style="list-style-type: none"> <li>▪ Brief review of regression</li> <li>▪ The Gold Standard: Experiments</li> </ul>	
February 8	<ul style="list-style-type: none"> <li>▪ <b>Guest Speaker: Daniel Player</b></li> <li>▪ Introduction to Natural Experiments Lotteries as a source of natural variation</li> </ul>	Reading presentation
February 15	<ul style="list-style-type: none"> <li>▪ More Natural Experiments: Difference-in-Difference Strategies</li> </ul>	Reading presentation
February 22	<ul style="list-style-type: none"> <li>▪ Instrumental Variable Approaches</li> </ul>	<b>Paper proposal due, via e-mail by 4 pm</b>  Reading presentation
March 1	<ul style="list-style-type: none"> <li>▪ Instrumental Variable Continued</li> </ul>	Reading presentation
March 8	<b>No Class, Spring Recess</b>	
March 15	<ul style="list-style-type: none"> <li>▪ Regression Discontinuity</li> </ul>	Reading presentation
March 22	<ul style="list-style-type: none"> <li>▪ Regression Discontinuity</li> </ul>	Reading presentation  <b>Referee Report Due, via e-mail by 4 pm</b>
March 29	<ul style="list-style-type: none"> <li>▪ Matching Strategies</li> </ul>	Reading presentation
April 5	<ul style="list-style-type: none"> <li>▪ Fixed Effects Models</li> </ul>	<b>OPTIONAL DRAFT PAPER due, via e-mail by 4 pm</b>  Reading presentation
April 12	<ul style="list-style-type: none"> <li>▪ Fixed Effects Application: Value-Added Models in Education</li> </ul>	Reading presentation
April 19	<ul style="list-style-type: none"> <li>▪ Comparing Quasi-Experimental Approaches</li> </ul>	Reading presentation
April 26	<ul style="list-style-type: none"> <li>▪ Recap</li> <li>▪ Final Presentations</li> </ul>	Reading presentation <b>Final paper presentation (in class)</b>
May 3	<ul style="list-style-type: none"> <li>▪ Final Presentations</li> </ul>	<b>Final paper presentation (in class)</b>

## Course Readings

This is a preliminary reading list. I reserve the right to make changes/substitutions based on student interest/time constraints, etc.

### 1. January 25: Class overview, Rubin Causal Model, The Logic of the Counterfactual

### 2. February 1: The Gold Standard: Experiments (and review of regression techniques)

Required readings (to be read before class today):

Murnane & Willett: Chapters 3 & 4

Cook, T. (2002) Randomized Experiments in Educational Policy Research: A Critical Examination of the Reasons the Educational Evaluation Community has Offered for not Doing Them. *Educational Evaluation and Policy Analysis*, 24 (3), 175-199.

Traub, James (2002). "Does It Work?" *New York Times Education Life*, November 10.

Multivariate regression (review as needed):

Stock & Watson (2007) Introduction to Econometrics

Chapter 6: Linear Regression with Multiple Regressors

Chapter 9: Assessing Studies Based on Multiple Regression

Supplementary Readings

Holland, P. (1986). Statistics and causal inference. *Journal of the American Statistical Association*, 81, 945-970.

Winship, C., & Morgan, S.L. (1999). The estimation of causal effects from observational data. *Annual Review of Sociology*, 25:659-707. Read pp 659-669.

### 3. February 8: Guest Lecture, Dan Player (Plus, Introduction to Natural Experiments Lotteries as a source of natural variation)

Required readings (to be read before class today):

Murnane & Willett: Chapter 5

Angrist, J. (2004) American Education Research Changes Tack, *Oxford Review of Economic Policy*

(P) Kreuger, A.B. (1999). Experimental estimates of education production functions. *The Quarterly Journal of Economics*, 114/2: 497-532.

Constantine, Player, et al (2009) An Evaluation of Teachers Trained Through Different Routes to Certification, *Mathematica Policy Research*. (Executive summary)

Supplementary Readings

What Works Clearinghouse

<http://ies.ed.gov/ncee/wwc/>

### 4. February 15: More Natural Experiments: Difference-in-Difference Strategies

Required readings (to be read before class today):

Murnane & Willett: Chapter 8

Angrist, J. (1990) Lifetime earnings and the Vietnam era draft lottery: Evidence from social security administrative records. *American Economic Review* 80(3) 313-36.

(P) Cullen, J.B., B.A. Jacob and S.E. Levitt (2006). "The Effect of School Choice on Participants: Evidence from Randomized Lotteries." *Econometrica*. 74:5, pp. 658-98.

Supplementary Readings

Kremer, M. & L (2008) Peer Effects and Alcohol Use among College Students. *Journal of Economic Perspectives*. 22 (3).

**5. February 16: Instrumental Variable Approaches**

Required readings (to be read before class today):

(P) Card, D. & Krueger, A.B. (1994). Minimum wages and employment: A case study of the fast-food industry in New Jersey and Pennsylvania. *The American Economic Review* 84:772-793.

Dynarski, S.M. (2003). Does aid matter? Measuring the effect of student aid on college attendance and completion. *The American Economic Review*, 3/1:279-288.

Supplementary Readings

Dee, T., & Jacob, B. (2009). The impact of No Child Left Behind on student achievement. National Bureau of Economic Research. Working Paper 15531.

Clotfelter, C., Glennie, E., Ladd, H., & Vigdor, J. (2008) Teacher Bonuses and Teacher Retention in Low Performing Schools: Evidence from the North Carolina \$1800 Bonus Program. *Public Finance Review*.36(1)

Reback, Rockoff & Schwartz (2010) Under Pressure: Job Security, Resource Allocation, and Productivity in Schools under NCLB.

**6. March 1: Instrumental Variables, Cont**

Required readings (to be read before class today):

Murnane & Willett: Chapter 10

Gennetian, L.A., Magnuson, K. & Morris, P. (2008) From Statistical Associations to Causation: What Developmentalists Can Learn From Instrumental Variables Techniques Coupled With Experimental Data, *Developmental Psychology*.

(P) Angrist, J. D., & Krueger, A. B. (1991). Does compulsory school attendance affect schooling and earnings? *The Quarterly Journal of Economics*, 106, 979-1014.

Supplementary Readings

Bound, J., Jaeger, D.A., Baker, R.M. (1995). Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak. *J. Am. Stat. Assoc.* 90:443 50.

**7. March 8: No Class, Spring Recess**

**8. March 15: Regression Discontinuity**

Required readings (to be read before class today):

Murnane & Willett: Chapter 11, Pg 265-280.

(P) Currie, J. & Moretti, E. (2003) Mother's Education and the Intergenerational Transmission of Human Capital

Angrist, J.D., & Krueger, A.B. (2001) Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments. 15(4) 69-85.

### **9. March 22: Regression Discontinuity, Cont.**

Required readings (to be read before class today):

Murnane & Willett: Chapter 9

(P) Robinson, J. P. (2010) The effects of test translation on young English learners' mathematics performance. *Educational Researcher*

Ludwig, J., Miller, D. L. (2007). Does head start improve children's life chances? Evidence from a regression discontinuity design. *The Quarterly Journal of Economics*. Vol. 122(1), pages 159-208.

Supplementary Readings

Niu, S. X., & Tienda, M. (2009). The impact of the Texas top ten percent law on college enrollment: A regression discontinuity approach. *Journal of Policy Analysis and Management* 29(1): 84-110. March 23

Cook, T. D., & Wong, V. C. (in press). Empirical tests of the validity of the regression discontinuity design. *Annales d'Economie et de Statistique*.

### **10. March 29: Matching Strategies**

Required readings (to be read before class today):

Angrist, Joshua and Victor Lavy (1999). "Using Maimonides' Rule to Estimate the Effect of Class Size on Scholastic Achievement." *Quarterly Journal of Economics* 114:2 (May), 533-602.

(P) Papay, J., Murnane, R., & Willett, J. (forthcoming). The consequences of high school exit examinations for low-performing urban students: evidence from Massachusetts. *Educational Evaluation and Policy Analysis*

### **11. April 5: Fixed Effects Models Fixed**

Required readings (to be read before class today):

Murnane & Willett: Chapter 12

(P) Morgan, S.L. (2001) Counterfactuals, causal effect heterogeneity, and the Catholic school effect on learning. *Sociology of Education*

Rosenbaum, P.R. (1986). Dropping out of high school in the United States: An observational study. *Journal of Educational Statistics*, 11/3:207-224.

Supplementary Readings:

Caliendo, M., & Kopenig, S. (forthcoming). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*.

Morgan, S.L., & Harding, D.J. (2006). Matching estimators of causal effects: Prospects and pitfalls in theory and practice. *Sociological Methods & Research*, 31/1:3-60.

Harding, D. J. (2003). Counterfactual Models Of Neighborhood Effects: The Effect Of Neighborhood Poverty On Dropping Out And Teenage Pregnancy. *American Journal of Sociology*, 109(3), 676-719.

**12. April 12: Effects Application: Value-Added Models in Education**

Required readings (to be read before class today):

(P) Garces, E., Thomas, D., & Currie, J. (2002). Longer-term effects of head start. *American Economic Review*, 999-1012.

Clotfelter, Ladd, & Vigdor (201) Teacher Credentials and Student Achievement in High School: A Cross-Subject Analysis with Student Fixed Effects

**13. April 19: Comparing Quasi-Experimental Approaches**

Required readings (to be read before class today):

Rivkin, S. (2007) Value-Added Analysis and Education Policy. Calder

Rubin, D., Stuart, E. & Zanutto, E. (2004) A Potential Outcomes View of Value-Added Assessment in Education. *Journal of Educational and Behavioral Statistics*. 29(1) 103-116.

(P) Kane, T. & Staiger, D. (2008) Estimating Teacher Impacts on Student Achievement: An Experimental Evaluation. *NBER Working Paper w14607*

Supplementary Readings

McCaffrey, D. et al (2003) *Evaluating value-added models for teacher accountability*. RAND

Rothstein, J. (2009) Student Sorting and Bias in Value-added Estimation: Selection on Observables and Unobservables. *Education Finance and Policy*

**14. April 26: Wrap-up/Final Paper Presentations**

Required readings (to be read before class today):

Murnane & Willett: Chapter 13

(P) Cook, Shadish & Wong (2008) Three conditions under which experiments and observational studies produce comparable causal estimates: New findings from within-study comparisons. *Journal of Policy Analysis & Management*.

Agodini, R., & Dynarski, M. (2004). Are experiments the only option? A look at dropout prevention programs. *The Review of Economics and Statistics*, 86(1), 180-194.

Supplementary Reading

Lalonde, R.J. (1986). Evaluating the econometric evaluations of training programs with experimental data. *The American Economic Review*, 76(4): 604-620.

**15. May 3: Final Presentations**