

EDUC-795: Quantitative Methods for Non-experimental Research Winter 2023

Instructor: Brian McCall (bpmccall@umich.edu)

Office: 2108B SEB (working from home this semester)

Office Hours: Tuesday 10:30 a.m.- 12:30 p.m. or by appointment (on Zoom)

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Instructor Assistant:

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Lecture Day & Time: Tuesday 1:00 p.m.-3:50 p.m.

Lecture Room: 2328 SEB

Lab Day & Time: Th 9:00 a.m.-11:00 a.m.

Lab Room: 2302 SEB

In Lab sessions you will continue learning the R software program, review material covered in class, and obtain answers to questions about class material, group projects and homework exercises.

Canvas:

Much of the communications for this course will be through on Canvas. This site includes:

- Announcements
- Assignments: Homework and Project Assignments
- Grades: Homework Grades
- Files: Lectures, Data, Documentation, Readings, etc.
- Syllabus: Online syllabus
- Discussions: Discussions about difficult statistical concepts, etc.

Course Description:

EDUC-795 is an intermediate course in quantitative methods that focuses on non-experimental methods. The course emphasizes the *application* of statistical concepts to problems in education. There is also specific instruction in the statistical software package R. Topics to be discussed include regression methods, factor analysis, reliability and validity, propensity score matching, and dichotomous choice models.

Prerequisites:

Students must have taken EDUC 793 or its equivalent.

Recommended Books:

Field, A., Miles, J. and Field, Z. (2012). *Discovering Statistics Using R*, Sage: London, ISBN-13: 978-1-4462-0045-2

Mehmetoglu, M. and Mittner, M. (2022). *Applied Statistics Using R: A Guide for the Social Sciences*, Sage: London, ISBN-13: 978-1-5264-7623-4

Other useful books:

Kline, P. (1994). *An easy guide to factor analysis*, Routledge: London, ISBN 9780415094900.

Agresti, A. and Finlay, B. (2018) *Statistical Methods for the Social Sciences, Fifth Edition* Pearson Education Limited, ISBN13 978-1-29-222031-4

Carmines, E.G. and R.A. Zeller (1999). *Reliability and Validity Assessment*. Sage, ISBN10 0803913710.

Jaccard, J. and R. Turrisi (2007) *Interaction Effects in Multiple Regression*. Sage, ISBN13 978-0-76-192742-6.

Kabacoff, R. I. (2022) *R in Action: Data Analysis and Graphics with R and Tidyverse*, Third Edition, Manning: Shelter Island, IBSN: 978-1-61-729605-5.

Lander, J. P. (2017). *R for Everyone: Advanced Analytics and Graphics*, Second Edition, Addison-Wesley: Boston, ISBN-13: 978-0-13-454692-6.

Walkey, F.H. and G. Welch (2010). *Demystifying Factor Analysis: How it works and How to Use it*. Xlibris Corp, ISBN13 978-1-45-000782-5

Software:

There are several statistical software programs, the four major ones being R, SAS, SPSS and R. For this class, we will use R. The R program is a good software program for advanced statistical methods and I use in it my research. Plus it is free!

Learning Objectives:

By the end of the course students will gain enough familiarity with:

- knowledge of intermediate statistical methods which will help students critically assess government and academic reports and research articles.
- the R software and statistical concepts to be able to perform more sophisticated statistical analysis on data, for example, multiple regression analysis, difference in differences estimation, regression discontinuity design, propensity score matching, factor analysis, MANOVA and MANCOVA.
- Different nationally representative datasets used in educational research such ECLS, ELS and HSLs to be comfortable conversing about them and use them in future research projects.
- Ability to produce an original research paper.

Responsibilities:

The best learning environment is a result of the efforts of both students and instructors. We can all learn a lot from one another, but we must each recognize our responsibilities to the group and our work this semester.

The responsibilities of the **student** include:

- reading the required articles and completing other assigned work on time.
- coming to the section prepared with questions about the readings or lecture.
- coming to the section on time and prepared to participate.
- respecting the views and learning needs of other students.
- consulting with the GSI or Professor about any problems in the course.

The responsibilities of the **Professor & GSI's** include:

- coming to lecture or section prepared to facilitate discussion and learning.
- being responsive to the needs of students in section and office hours.
- giving students guidance about how to improve their performance.
- respecting the views and learning needs of the students.
- working with students to resolve any problems in the course.

Data Sets Used in Class:

In this class, many of the exercises in the homework, as well as the group project, will come from three data sets that are widely used in educational research.

Early Childhood Longitudinal Study (ECLS) conducted by the National Center for Education Statistics

Education Longitudinal Study of 2002 (ELS) conducted by the National Center for Education Statistics.

High School Longitudinal Study of 2009 (HSLs) conducted by the National Center for Education Statistics.

Brief Descriptions of the Data:

The Early Childhood Longitudinal Study (ECLS-K:2011) is the third and latest study in the ECLS program, which comprises three longitudinal studies of young children: the Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K); the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B); and the ECLS-K:2011. The ECLS program is wide in its scope and coverage of child development, early learning, and school progress, drawing together information from many sources, including school administrators, parents, teachers, early care and education providers, and children. The ECLS-K:2011 provides up-to-date information about elementary school children and data relevant to emerging policy-related domains not available in the previous studies. Also, when combined with the ECLS-K, the ECLS-K:2011 allows for cross-cohort comparisons of two nationally representative kindergarten classes experiencing different policy, educational, and demographic environments.

The Education Longitudinal Study of 2002 (ELS) is designed to monitor the transition of a national sample of young people as they progress from tenth grade through high school and on to postsecondary education and/or the world of work. In the first year of data collection (the 2002 base year) ELS:2002 measured students' tested achievement and

obtained information about their attitudes and experiences. These same students were surveyed and tested again, two years later in 2004 to measure their achievement gains in mathematics, as well as changes in their status, such as transfer to another high school, early completion of high school, or leaving high school before graduation. In the third round of data collection in 2006, information was collected about colleges applied to and aid offers received, enrollment in postsecondary education, employment and earnings, and living situation, including family formation. In addition, high school completion status was updated for those who had not completed as of the third round of data collection. Cohort members will be interviewed again in 2012 so that later outcomes, such as their persistence and attainment in higher education, or their transition into the labor market, can be understood in terms of their earlier aspirations, achievement, and high school experiences.

The High School Longitudinal Study of 2009 (HSLs) is a nationally representative, longitudinal study of 23,000+ 9th graders from 944 schools in 2009, with a first follow-up in 2012 and a second follow-up in 2016. Students followed throughout secondary and postsecondary years. Surveys of students, their parents, math and science teachers, school administrators, and school counselors. A new student assessment in algebraic skills, reasoning, and problem solving for 9th and 11th grades.

Online codebooks and data for these studies are available at <https://nces.ed.gov/onlinecodebook>.

Course Grading:

A student's grade will consist of their performance in three areas class participation, homework, and the group research project.

The relative breakdown of each of these areas in determining a student's overall grade is as follows.

- **10% Class Participation**
 - Class participation includes attending class and labs, actively participating in all group activities during class and labs, turning in all non-graded exercises in class and participating in class and lab discussions.
- **40% Homework**
 - Homework assignments must be turned in the day that they are due. Late homework assignments will receive an automatic 10% reduction in points.
- **50% Empirical research project**
 - The empirical research project is a semester-long project that will result in a research paper.

- Each person will choose a research topic that can be studied using either the ELS, HSLS or ECLS data (or, in some cases alternative data that has received prior approval by instructor.
- Each person will be required to make a 20-minute presentation in class discussing their findings and an approximately 25-page research paper (not including tables and figures) which is a write up of the research project.
- One-third of the grade for the empirical research project is determined by the presentation while two-thirds of the grade is determined by the paper.
- More information about the empirical research project will be given in class during the lecture in the second week.

If you feel you need an accommodation for any sort of disability, please make an appointment to see me during my office hours.

Retention of Documents

Documents that are submitted by students in this course that are not picked up by students will be retained by the Professor until December 31, 2021, and then discarded.

Course Topics:

- A Brief Review of Statistical Inference
- Simple Linear Regression
- Multiple Regression (Field et al. Chapter 7, Mehmetoglu & Mittner Chapters 7-10)
- Assumptions of Regression Model (Field et al. Chapter 7, Mehmetoglu & Mittner Chapters 7-10)
 - Overall Test of Model
 - Modeling Categorical Predictor Variables
 - Testing Part of the Model
 - Overall Test of Model
 - Modeling Non-Linear Effects
 - Heteroskedasticity
 - Multicollinearity
 - Outliers and Influence
 - Weighted Regressions
 - Endogenous Regressors & Two-Stage Least Squares
 - Panel Data
- Linear Probability Models and Logits (Field et al. Chapter 8, Mehmetoglu & Mittner Chapter 11)
- ANOVA-ANCOVA (Field et al. Chapter 10 & 11)
- Factorial ANOVA (Field et al. Chapter 12)
- MANOVA-MANCOVA (Field et al. Chapter 16)

- Factor Analysis (Field et al. Chapter 17, Mehmetoglu & Mittner Chapter 13 & 14)
 - Principal Components Analysis
 - Methods of Rotation
 - Confirmatory Factor Analysis
 - Reliability and Validity
- Quasi-Experimental methods
 - Difference in Differences Estimation
 - Propensity Score Matching
 - Regression Discontinuity Design

Additional Readings

In many lectures we will be discussing quantitative studies in education. Readings for the following week will be announced in class and be made available on canvas the week before. All readings are available on canvas in pdf format. Some of the readings are listed below.

Ake-Little, E., von der Embse, N., & Dawson, D. (2020). "Does Class Size Matter in the University Setting?" *Educational Researcher*, **49**(8): 595-605.

Boatman, A., & Long, B.T. (2018). "Does Remediation Work for All Students? How the Effects of Postsecondary Remedial and Developmental Courses Vary by Level of Academic Preparation." *Educational Evaluation and Policy Analysis* **40**(1): 29-58.

Bridgeman, B., Burton, N., et al. (2003). "Substituting SAT II: Subject Tests for SAT I: Reasoning Tests: Impact on Admitted Class Composition and Quality." *Research in Higher Education* **44**(1): 63-96.

Cogan, L. S., Schmidt, W. H., et al. (2001). "Who Takes What Math and in Which Track? Using TIMSS to Characterize U.S. Students' Eighth-Grade Mathematics Learning Opportunities." *Educational Evaluation and Policy Analysis* **23**(4): 323-341.

DesJardins, S. L., & McCall, B.P. (2014). The impact of the Gates Millennium Scholars Program on college and post-college related choices of high ability, low-income minority students. *Economics of Education Review*, **38**: 124-138.

DesJardins, S. L., McCall, B. P., et al. (2010). "A Quasi-Experimental Investigation of How the Gates Millennium Scholars Program Is Related to College Students' Time Use and Activities." *Educational Evaluation and Policy Analysis* **32**(4): 456-475.

- Fitzpatrick, M. D., Grissmer, D., et al. (2011). "What a Difference a Day Makes: Estimating Daily Learning Gains During Kindergarten and First Grade Using a Natural Experiment." *Economics of Education Review* **30**(2): 269-279.
- Fuller, B., Kim, Y., et al. (2019). "Worsening School Segregation for Latino Children?," *Educational Researcher* **48**(7): 407-420.
- Hill, C. B. & Winston, G. C. (2010). "Low-income students and highly selective private colleges: Geography, searching, and recruiting." *Economics of Education Review* **29**(4): 495-503.
- Lin, H.-L., Lawrence, F., et al. (2003). "Kindergarten Teachers' Views of Children's Readiness for School." *Early Childhood Research Quarterly* **18**(2): 225-237.
- Marsh, H. W. & Hattie, J. (2002). "The Relation Between Research Productivity and Teaching Effectiveness." *Journal of Higher Education* **73**(5): 603-641.
- Massey, D. S., Mooney, M., et al. (2007). "Black Immigrants and Black Natives Attending Selective Colleges and Universities in the United States." *American Journal of Education* **113**: 243-271.
- May, H. & Supovitz, J. (2006). "Capturing the Cumulative Effects of School Reform: An 11-Year Study of the Impacts of America's Choice on Student Achievement." *Education Evaluation and Policy Analysis* **28**(3): 231-257.
- McCall, B.P. & Bielby, R. (2012). "Regression Discontinuity Design: Recent Developments and a Guide to Practice for Researchers in Higher Education," in John Smart and Michael Paulsen (Ed.) *Higher Education: Handbook of Theory and Research XXVII*, 249-290.
- Meyer, J. H. F. (1995). "Gender-group Differences in the Learning Behaviour of Entering First-year University Students." *Higher Education* **29**(2): 201-215.
- Monk, D. H. & Ibrahim, M. A. (1984). "Patterns of Absence and Pupil Achievement." *American Educational Research Journal* **21**(2): 295-310.
- Morris, D., Blanton, L., et al. (1995). "Spelling Instruction and Achievement in Six Classrooms." *The Elementary School Journal* **96**(2): 145-162.
- Moust, J. C. & Schmidt, H. G. (1994). "Effects of Staff and Student Tutors on Student Achievement." *Higher Education* **28**(4): 471-482.

- Okagaki, L. & Frensch, P. A. (1998). "Parenting and Children's School Achievement: A Multiethnic Perspective." *American Educational Research Journal* **35**(1): 123-144.
- Ortagus J.C., & Hu, X. (2019). "The Price of Mission Complexity: A National Study of the Impact of Community College Baccalaureate Adoption on Tuition and Fees," *Educational Researcher* **48**(8) 504-520.
- Pascarella, E. T., Wolniak, G. C., et al. (2003). "Influences on Community College Students' Educational Plans." *Research in Higher Education* **44**(3): 301-314.
- Reynolds, C. L. & DesJardins, S. L. (2009). "The Use of Matching Methods in Higher Education Research: Answering Whether Attendance at a 2-Year Institution Results in Differences in Educational Attainment." J.C. Smart (ed.), *Higher Education: Handbook of Theory and Research* 47-104.
- Soliz, A. (2018). "The Effects of the Expansion of For-Profit Colleges on Student Enrollments and Outcomes at Community Colleges ." *Educational Evaluation and Policy Analysis* **40**(4): 631-652.
- Wapole, S., McKenna, M. C., et al. (2010). "The Relationships between Coaching and Instruction in the Primary Grades: Evidence from High-Poverty Schools." *The Elementary School Journal* **111**(1): 115-140.
- Xu, J. & Corno, L. (2003). "Family Help and Homework Management Reported by Middle School Students." *The Elementary School Journal* **103**(5): 503-517.