

SOCIOLOGY 6708
ADVANCED DATA ANALYSIS:
FIXED EFFECTS PANEL MODELS USING A STRUCTURAL EQUATIONS APPROACH

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OVERVIEW

The focus of this course is on Fixed Effects Panel Models, focusing on the implementation proposed by Allison (2009) and Bollen and Brand (2019) using structural equation models (SEM).

I will specifically follow the Allison – Williams -- Moral-Benito (2019) method using SEM as the basis for studying fixed effects. It is a very general method for taking into account unmeasured heterogeneity --- a general term for all stable individual differences, including fixed genetic and biological inputs (though they interact with experience over time), parental demographics and SES background, past completed life history, such as completed education, and any primarily stable statuses or roles over the life course. There are a number of advantages built into this implementation, including: the ability to include fixed variables explicitly in the analysis, accounting for reverse causation, methods for comparing processes across groups, and estimation of the amount of confounding between the individual random effect in the model and focal variables in the model.

This method can be applied to any data set that has multiple measures over time on the same individuals or social units – which is most large panel studies, but also includes purpose-dedicated intervention studies. I will emphasize the implementation of this method that promotes comparison of results across groups --- allowing comparisons *and testing* of gendered processes, race differences, nativity differences, immigrants vs refugees, first vs. second generation, life stages or cohorts, etc. Of course, students can choose to study a single group if preferred.

In one sense, this is an approach from a very different perspective than is represented by the counterfactual model, aka the potential outcome model, which we will also discuss in this course. We WILL take some time to discuss the modern discussion of causality in epistemology, beyond the classics, such as the “reliabilist” theory of Alvin Goldman, because these debates form the basis of what we believe – or reject – about causation.

The course has a basic purpose: to get you to write a research paper using the method that could act as a first draft of a dissertation paper, or for submission to a conference or journal, or as a first draft of a Ph.D. practicum paper You will be able to use the data you want. But note: You should come to class with an idea derived from a literature you intend to contribute to and also have access to longitudinal data that can be used in your paper. The data must be have at least a three-wave panel structure.

You can use any of the statistical software packages that include some module for structural equation models, including R, Stata, SAS, SPSS, or dedicated software like M-Plus. I do not want to require any specific knowledge of any one piece of software; however, I will be most helpful with SAS, STATA, SPSS, and R, in that order.

During the class, I will report on a running example using the NLSY, and possibly the PSID, to investigate the causal role of social class / SES in producing mental health disparities over time. This running example will act as a template for what students will do in their papers.

Why are these methods potentially important? I will offer a small example: In class we will review an example using fixed effects that completely changes out interpretation of the impact of marriage on well-being / mental health, because only in fixed effects models does cohabitation equal the positive benefits of marriage, while the literature claims, typically, it has much weaker benefits. Note that this finding would change our theoretical interpretation about what counts in the association between relationships and well-being. This example signals a larger possibility: that findings with considerable inertial acceptance in many literatures may be critically re-examined using these techniques.

CLASSES AND SCHEDULE

It is expected that students attend all classes. Class attendance will count for 10% of the grade in this course. A full 10% will be given for attendance at 11 of 12 of the classes, with allowance for one missed class due to illness or unavoidable circumstances without explanation. If you miss more than one class, consideration will be given to medical illness or unavoidable scheduling conflicts.

The first class will be on Tuesday, January 11th. This is noted in the detailed schedule below.

A broad outline of the course is as follows:

- **First three weeks:** readings on fixed effects panel models, with emphasis on the Allison / Williams/ Moral-Benito version, and how it is specified, including critiques of fixed effects. These classes will basically be lectures plus discussion of your data and the requirements necessary for your analysis.
- **Week four:** demonstrations of syntax for estimating these models in SAS and STATA. Again, we will take time to translate template examples into the specific applications you will use for your papers.
- **Week five:** consideration of published implementations of these methods in different areas. This will include class discussion of the presentation of and interpretive thinking accompanying these methods.
- **Weeks six through eight:** students rotate presentations on their research paper, including plans for analysis, and any early results.
- **Weeks nine and ten:** we consider this method in relation to other methods used to study causality.
- **Weeks eleven and twelve:** students present final versions of results for their papers.

The main prerequisites for this course are a regression-level understanding of data analysis – no more. The specific SEM implementation will be taught as part of the course.

Required work includes: class attendance, 10%, two presentations, each worth 20%, and a final paper, due one week after the end of class, worth 50%.

REQUIRED WORK AND GRADING

The table below states the weights assigned for each piece of work in this course:

Required Work	Date	Number / Weight	Total Weight
Class attendance: 11 of 12 weeks with one point deducted for each week missed beyond 1.	weekly	10%	10%
In-class presentations	by choice: weeks 6 through 8 weeks 11 and 12	2 x 20%	40%
Final complete paper	April 22nd	50%	50%

PAPER

The final research paper is a complete draft of a research paper suitable for revision and submission to a professional conference or journal. It can be 8,000 to 15,000 words long, including all tables and figures.

All students may use their own data, with these conditions: the data are from a multi-wave (three or more waves) panel study of the same people, or social units (e.g., institutions), and the sample size is sufficient for application of the course methods. There is no hard-and-fast rule about this, but to avoid problems deep into the course, I suggest data with an N above 500, and would recommend data beyond N=1000 if possible.

Students are responsible for coding their data, understanding the measures, the sampled population, and the structure of the data set. I can help resolve these issues as the course progresses.

To implement the methods in this course, the panel data must have *the same* measures across at least three waves for the variables you select to study.

GRADING DETAILS

I use the following guidelines for translating letter grades into numeric equivalents. This is important because you can only derive an overall numeric grade by using this translation. In general, I use a midpoint equivalent at each letter grade level.

I also add “borderline” grades, reflecting what I feel is appropriate for work clearly on the border between two grade levels. This helps create finer distinctions in final grades.

Letter Grade	Numerical Equivalent
A+	95
A / A+	90
A	87
A- / A	85
A-	82
B+ / A-	80
B+	78
B / B+	77
B	75
B- / B	73
B-	71
FZ**	0 - 69%

READINGS

In this course, the readings are introductory discussion of the methods we will apply. The course is more about doing than reading. But you *will* have to include literature for the introduction section of your paper setting up the research problem you address in your paper.

WEEKS 1-3: INTRODUCTION TO THE METHOD

JANUARY 11, 18, 25.

***Introduction to the Fixed Effects Approach;
Advantages and Disadvantages;
SEM Approach and What It Resolves and Reveals;
Literature Examples;
Issues in Causality.***

**** Assigned***

*Blair Wheaton and Marisa Young. 2021. **Generalizing the Regression Model: Techniques for Longitudinal and Contextual Analysis.** Los Angeles: Sage Publications. Chapters 13 and 14.

*Allison PD, Williams R, Moral-Benito E. Maximum Likelihood for Cross-lagged Panel Models with Fixed Effects. *Socius*. January 2017.

Allison PD. Asymmetric Fixed-effects Models for Panel Data. *Socius*. January 2019.

Allison, P. D. (2009). *Fixed effects regression models*. Thousand Oaks, CA: Sage

*Bollen, K. A., Brand, J. E. (2010). A general panel model with random and fixed effects: A structural equations approach. *Social Forces*, 89(1), 1–34. doi:10.1353/sof.2010.0072.

Zyphur MJ, Allison PD, Tay L, et al. From Data to Causes I: Building A General Cross-Lagged Panel Model (GCLM). *Organizational Research Methods*. 2020;23(4):651-687.

Zyphur MJ, Voelkle MC, Tay L, et al. From Data to Causes II: Comparing Approaches to Panel Data Analysis. *Organizational Research Methods*. 2020;23(4):688-716.

*Hill TD, Davis AP, Roos JM, French MT. Limitations of Fixed-Effects Models for Panel Data. *Educational Administration Quarterly*. 2020;63(3):221-258.

*Vaisey S, Miles A. What You Can—and Can't—Do With Three-Wave Panel Data. *Sociological Methods & Research*. 2017;46(1):44-67.

WEEK 4 SYNTAX FOR ESTIMATING FE MODELS IN STRUCTURAL EQUATIONS CONTEXT.

FEBRUARY 1

Syntax Examples in SAS, STATA, and R.

Paul Allison. 2005 *Fixed Effects Regression Methods for Longitudinal Data Using SAS*. Cary, NC: SAS Institute.

Richard Williams, Paul D. Allison, and Enrique Moral-Benito. 2018. Linear dynamic panel-data estimation using maximum likelihood and structural equation modeling. *The Stata Journal* 18: 293-326.

Henrik Kenneth Andersen (2021) A Closer Look at Random and Fixed Effects Panel Regression in Structural Equation Modeling Using Lavaan, *Structural Equation Modeling: A Multidisciplinary Journal*, DOI: 10.1080/10705511.2021.1963255

WEEK-5: APPLICATIONS.

FEBRUARY 8

NOTE: This section is not complete. We will choose 3-4 readings to consider for this class. More options will be provided by the time the class is offered.

In-class discussion of applications of this method in the literature

Ozan Aksoy and Dingeman Wiertz 2021 The impact of religious attendance on trust, volunteering, and cooperation: A cross-lagged panel analysis with individual fixed-effects. Working paper 21-11. UCL Social Research Institute.

Paula England, Paul Allison, Yuxiao Wu, 2007. Does bad pay cause occupations to feminize, Does feminization reduce pay, and How can we tell with longitudinal data?, *Social Science Research*, Volume 36, Issue 3, Pages 1237-1256.

Zahl-Thanem Tonje, Steinsbekk Silje, Wichstrøm Lars. 2018. Predictors of Physical Activity in Middle Childhood. A Fixed-Effects Regression Approach . *Frontiers in Public Health* VOLUME=6: 1-8.

Anna Nyberg, Paraskevi Peristera, Hugo Westerlund, Gunn Johansson, Linda L Magnusson Hanson, Does job promotion affect men's and women's health differently? Dynamic panel models with fixed effects, *International Journal of Epidemiology*, Volume 46, Issue 4, August 2017, Pages 1137–1146, <https://doi.org/10.1093/ije/dyw310>

Rafael Quintana, 2021. Thinking within-persons: Using unit fixed-effects models to describe causal mechanisms, *Methods in Psychology*, Volume 5, 2590-2601.

WEEKS 6-8: STUDENT PRESENTATIONS ON THE REQUIRED RESEARCH PAPER

FEBRUARY 15, MARCH 1, MARCH 8

***Per week, 1-2 students will present:
Literature Review and Derived Research Question
Intended Data, Study Design, Variables to be Used
Analytical Plan to Address Research Question***

No assigned readings; students will present readings used in their literature review.

WEEK 9-10: COMPARING CONCEPTS OF CAUSALITY ACROSS METHODS.

MARCH 15, 22.

In-class discussion / presentation of the overlapping vs. distinct views of requirements for causality and causality across different recent and traditional methods .

Student updates on ongoing analyses for their papers.

NOTE: 4-5 readings will be chosen for maximum contrast in understandings of criteria for causal inference.

Blair Wheaton and Marisa Young. 2021. **Generalizing the Regression Model: Techniques for Longitudinal and Contextual Analysis.** Los Angeles: Sage Publications. Chapter 6.

Judea Pearl. 2010. An Introduction to Causal Inference. *The International Journal of Biostatistics* 6:2.

Donald Campbell and Julian Stanley. 1963. *Experimental and Quasi-Experimental Designs for Research.* Boston: Houghton-Mifflin.

Alvin Goldman. 1999. Knowledge in a Social World. Oxford: Oxford University Press. Review of Concepts by Jennifer Nagel at: PHILOSOPHY - Epistemology: Analyzing Knowledge #3 (Causal and Reliabilist Theories) [HD] - YouTube

Henry E. Brady. 2011 Causation and Explanation in Social Science *The Oxford Handbook of Political Science* (ed Robert E. Goodin). 62 pages.

Causal Inference in Statistics: A Primer, First Edition. Judea Pearl, Madelyn Glymour, and Nicholas P. Jewell. © 2016 John Wiley & Sons, Ltd. Chapter 4.

Carlos Cinelli, Andrew Forney and Judea Pearl .2019. Causal Analysis in Theory and Practice » A Crash Course in Good and Bad Control (ucla.edu).

M Hofler. Causal Inference Based on Counterfactuals. BMC Medical Research 5:28: 1-12.

Herbert Smith. 2013. Research Design: Toward a Realistic Role for Causal Analysis. Pp. 45-74 in Handbook of Causal Analysis, Stephen L. Morgan (ed.) New York: Springer.

Kenneth Bollen and Judea Pearl. 2013. Eight Myths about Causality and Structural Equation Models. Pp. 310-330 in Handbook of Causal Analysis, Stephen L. Morgan (ed.) New York: Springer.

Stephen Morgan and Christopher Winship. 2007. Counterfactuals and Causal Inference. New York: Cambridge University Press. Chapters 1 and 2.

Miguel Hernan and James Robins. 2020. Causal Inference: What If? CRC Press. Chapters 1 and 2.

Ann Berrington, WF Smith, and Patrick Sturgis. 2006. An Overview of Methods for the Analysis of Panel Data. ESRC National Centre for Research Methods Briefing Paper. NCRM/007.

Margaret Mooney Marini and Burton Singer. 1988. Causality in the Social Sciences Author(s): Source: Sociological Methodology, Vol. 18 (1988), pp. 347-409.

WEEK 11-12: FINAL STUDENT PRESENTATIONS OF FINDINGS FOR PAPERS.

MARCH 29, APRIL 5

Students will present half hour reports on the findings for their papers, with comments and questions.

The following parts of the syllabus are a required template, but also express important principles, procedures, and values.

PENALTY FOR LATENESS CLAUSE

For both undergraduate and graduate courses, instructors are not obliged to accept late work, except where there are legitimate, documented reasons beyond a student's control. In such cases, a late penalty is normally not appropriate.

In this course, the required work schedule is determined by choices of week in the initial class. The final paper is due April 22nd. A late paper must be accompanied by a medically certified explanation or evidence of a scheduling conflict. However, late papers submitted more than

three weeks after the last class (April 26th) without explanation will receive a 10% discount in the grade – not in the weight.

ACADEMIC INTEGRITY CLAUSE

Copying, plagiarizing, falsifying medical certificates, or other forms of academic misconduct will not be tolerated. Any student caught engaging in such activities will be referred to the Dean's office for adjudication. Any student abetting or otherwise assisting in such misconduct will also be subject to academic penalties. Students are expected to cite sources in all written work and presentations. See this link for tips for how to use sources well:

(<http://www.writing.utoronto.ca/advice/using-sources/how-not-to-plagiarize>).

According to Section B.I.1.(e) of the Code of Behaviour on Academic Matters it is an offence “to submit, without the knowledge and approval of the instructor to whom it is submitted, any academic work for which credit has previously been obtained or is being sought in another course or program of study in the University or elsewhere.”

By enrolling in this course, you agree to abide by the university's rules regarding academic conduct, as outlined in the Calendar. You are expected to be familiar with the Code of Behaviour on Academic Matters (<http://www.artsci.utoronto.ca/osai/The-rules/code/the-code-of-behaviour-on-academic-matters>) and Code of Student Conduct (<http://www.viceprovoststudents.utoronto.ca/publicationsandpolicies/codeofstudentconduct.htm>) which spell out your rights, your duties and provide all the details on grading regulations and academic offences at the University of Toronto.

ACCESSIBILITY SERVICES

It is the University of Toronto's goal to create a community that is inclusive of all persons and treats all members of the community in an equitable manner. In creating such a community, the University aims to foster a climate of understanding and mutual respect for the dignity and worth of all persons. Please see the University of Toronto Governing Council “[Statement of Commitment Regarding Persons with Disabilities](https://governingcouncil.utoronto.ca/secretariat/policies/statement-commitment-regarding-persons-disabilities-february-25-2021)” at <https://governingcouncil.utoronto.ca/secretariat/policies/statement-commitment-regarding-persons-disabilities-february-25-2021>.

In working toward this goal, the University will strive to provide support for, and facilitate the accommodation of individuals with disabilities so that all may share the same level of access to opportunities, participate in the full range of activities that the University offers, and achieve their full potential as members of the University community. We take seriously our obligation to make this course as welcoming and accessible as feasible for students with diverse needs. We also understand that disabilities can change over time and will do our best to accommodate you.

Students seeking support must have an intake interview with a disability advisor to discuss their individual needs. In many instances it is easier to arrange certain accommodations with more advance notice, so we strongly encourage you to act as quickly as possible. To schedule a registration appointment with a disability advisor, please visit Accessibility Services at <http://www.studentlife.utoronto.ca/as>, call at 416-978-8060, or email at: accessibility.services@utoronto.ca. The office is located at 455 Spadina Avenue, 4th Floor, Suite 400.

Additional student resources for distressed or emergency situations can be located at distressedstudent.utoronto.ca; Health & Wellness Centre, 416-978-8030, <http://www.studentlife.utoronto.ca/hwc>, or Student Crisis Response, 416-946-7111.

EQUITY AND DIVERSITY

All members of the learning environment in this course should strive to create an atmosphere of mutual respect. It is our collective responsibility to create a space that is inclusive and welcomes discussion. Discrimination, harassment and hate speech will not be tolerated; please alert me to any behaviour that undermines the dignity or self-esteem of any person in this course or otherwise creates an intimidating or hostile environment. You'll find additional information and reports on Equity and Diversity at the University of Toronto online at <http://equity.hrandequity.utoronto.ca>.