

**Political Science 636**  
**Measurement, Scaling, and Covariance Structure Models**  
**Fall 2025<sup>1</sup>**

**Professor**

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**Class**

Th 9:30AM-12:20PM N-705 SBS  
Office Hours: Tu/Th 1-230pm or by appointment

**Course Overview**

This course will consider major contemporary approaches to social and political measurement, with extensions to deal with issues like measurement invariance (multiple group and cross-national data), and longitudinal data. Topics will include classical measurement theory, estimation of reliability, item response theory, factor analysis, and general latent variable models (structural equation modeling). The lectures and readings will examine the statistical models, substantive applications, and the practical problems of applying these models to data (including the software available in each case). Empirical examples in class will demonstrate the utility of various R packages and other major software for estimating measurement models.

**Course Objectives**

At the end of this course students will be able to:<sup>2</sup>

- Understand and interpret common measurement modeling approaches.
- Apply these models to their own research questions.
- Critique others' applications of these methods.

**Course Requirements and Grades**

This is a PhD class and, as such, final grades can be viewed in the following light: A/A- above average content mastery, B-/B/B+ average content mastery, below B- failing.

*Homework Assignments (30%)*

I will provide occasional homework assignments related to techniques we discuss in class. These will be graded on a pass/fail basis. They will focus on implementation method and your appraisal of the measurement choices and decisions applied researchers have taken.

There are no word count limits but precision in writing is important. You may typeset this in any program, but please submit as a PDF.

*Project Paper (70%)*

You will complete an individual project applying one or more methods from the course to a topic of interest. This might be an analysis of an existing survey scale or reassessment of measurement choices in published work, with an emphasis on item and/or test characteristics. This might also focus on persons, with the aim to better explain outcomes. We will see examples of both this semester. Please come talk with me about your ideas before embarking on the project.

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<sup>1</sup> Syllabus version August 8, 2025

<sup>2</sup> Know that it's pronounced LICK-ert, not LIKE-ert.

You may combine this with an assignment for another class, but before proceeding please discuss this with me and confirm with the instructor in the other class.

Complete this in the format of a short article, with a maximum of around 4000 words. You may typeset this in any program, but please submit as a PDF. Keep the intro and conclusion brief, but sufficient to detail the puzzle or problem and your takeaways from your analysis. Write up the methods section and the results section assuming the reader has no background in measurement modeling.

### **Academic Integrity**

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Professions, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at:

[http://www.stonybrook.edu/commcms/academic\\_integrity/index.html](http://www.stonybrook.edu/commcms/academic_integrity/index.html)

### **Student Accessibility Support Center**

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at [sasc@stonybrook.edu](mailto:sasc@stonybrook.edu). They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

### **Critical Incident Management**

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

### **Course Material and Unit Schedule**

Please purchase the following books. All other assigned book chapters, journal articles, and working papers will be posted to Brightspace. If any are missing, please let me know.

- de Ayala, R. J. 2022. *The Theory and Practice of Item Response Theory*. 2nd ed. New York: The Guilford Press.
- Kline, Rex B. 2023. *Principles and Practice of Structural Equation Modeling*. Fifth edition. New York: The Guilford Press.

Most every week's assigned material includes both technical aspects and applications. Read the technical pieces first before proceeding to the applied. Many weeks will also include live coding

exercises in class to build from the applied articles. I will share PDFs with worked examples of model estimation and evaluation in R as an additional resource.

### **August 28:** Introduction to Measurement

Process of measurement; measurement as theory testing; consequences for hypothesis testing

#### *Technical*

- Personality Project Chapter 2: A Theory of Data.  
(accessible: <https://www.personality-project.org/r/book/>)

#### *Applied*

- Wuttke, Alexander, Christian Schimpf, and Harald Schoen. 2020. "When the Whole Is Greater than the Sum of Its Parts: On the Conceptualization and Measurement of Populist Attitudes and Other Multidimensional Constructs." *American Political Science Review* 114(2): 356–74.

### **September 4:** Latent Variable Models and Factor Analysis

Common factor model vs. Principal Components Analysis; Exploratory vs. Confirmatory FA

#### *Technical*

- Tucker, Ledyard, and Robert C MacCallum. *Exploratory Factor Analysis*. Chs 1, 3 and 4 (<https://labs.dgsom.ucla.edu/hays/files/view/docs/factor.pdf> and on Brightspace)
- Reise, Steven P., Niels G. Waller, and Andrew L. Comrey. 2000. "Factor Analysis and Scale Revision." *Psychological Assessment* 12(3): 287–97. doi:[10.1037/1040-3590.12.3.287](https://doi.org/10.1037/1040-3590.12.3.287).
- Fabrigar, Leandre R, Duane T Wegener, Robert C MacCallum, and Erin J Strahan. 1999. "Evaluating the Use of Exploratory Factor Analysis in Psychological Research." *Psychological Science* 4(3): 272–99.

### **September 11:** Exploratory Factor Analysis

Factor extraction, factor rotation, factor scores

#### *Technical*

- Personality Project Chapter 6: Constructs, Components, and Factor Models.  
(accessible: <https://www.personality-project.org/r/book/>)
- Zwick, William R., and Wayne F. Velicer. 1986. "Comparison of Five Rules for Determining the Number of Components to Retain." *Psychological Bulletin* 99(3): 432–42.
- Jennrich, Robert I., and Peter M. Bentler. 2011. "Exploratory Bi-Factor Analysis." *Psychometrika* 76(4): 537–49. doi:[10.1007/s11336-011-9218-4](https://doi.org/10.1007/s11336-011-9218-4).

#### *Applied*

- Kosterman, Rick, and Seymour Feshbach. 1989. "Toward a Measure of Patriotic and Nationalistic Attitudes." *Political Psychology* 10(2): 257–74.

### **September 18:** Covariance Structure Models

Limits of EFA, Intro to structural equation modeling

#### *Technical*

- Kline 2023, Chs 6-9

- Bollen, Kenneth A., Jeffrey J. Harden, Surajit Ray, and Jane Zavisca. 2014. “BIC and Alternative Bayesian Information Criteria in the Selection of Structural Equation Models.” *Structural Equation Modeling: A Multidisciplinary Journal* 21(1): 1–19.

#### *Applied*

- Pérez, Efrén O. 2011. “The Origins and Implications of Language Effects in Multilingual Surveys: A MIMIC Approach with Application to Latino Political Attitudes.” *Political Analysis* 19(4): 434–54.
- Schneider, Frank M., Lukas Otto, Daniel Alings, and Manfred Schmitt. 2014. “Measuring Traits and States in Public Opinion Research: A Latent State–Trait Analysis of Political Efficacy.” *International Journal of Public Opinion Research* 26(2): 202–23.

### **September 25:** Covariance Structure Models: Estimation and Model Fit

Data requirements, estimators, goodness of fit statistics

#### *Technical*

- Kline 2023, Ch 11-13
- Saris, Willem E, Albert Satorra, and William M van der Veld. 2009. “Testing Structural Equation Models or Detection of Misspecifications?” *Structural Equation Modeling: A Multidisciplinary Journal* 16(4): 561–82.
- Preacher, Kristopher J, Li Cai, and Robert C MacCallum. 2007. “Alternatives to Traditional Model Comparison Strategies for Covariance Structure Models.” In *Modeling Contextual Effects in Longitudinal Studies*, eds. Todd D Little, James A Bovaid, and Noel A Card. Mahwah: Lawrence Erlbaum Associates, 33–62.
- Optional: Muthén, Bengt, and Tihomir Asparouhov. 2012. “Bayesian Structural Equation Modeling: A More Flexible Representation of Substantive Theory.” *Psychological Methods* 17(3): 313–35.

#### *Applied*

- Castanho Silva, Bruno, Sebastian Jungkunz, Marc Helbling, and Levente Littvay. 2020. “An Empirical Comparison of Seven Populist Attitudes Scales.” *Political Research Quarterly* 73(2): 409–24. **Read: 409-13**
- One of:
  - Huddy, Leonie, and Nadia Khatib. 2007. “American Patriotism, National Identity, and Political Involvement.” *American Journal of Political Science* 51(1): 63–77.
  - Tarman, Christopher, and David O Sears. 2005. “The Conceptualization and Measurement of Symbolic Racism.” *The Journal of Politics* 67(3): 731–61.

### **October 2:** Classical Test Theory

True scores, reliability, errors-in-variables models

#### *Technical*

- Personality Project (<https://www.personality-project.org/r/book/>), Ch. 7: Reliability
- de Ayala 2022, Ch 1
- Wiley, David E, and James A Wiley. 1970. “The Estimation of Measurement Error in Panel Data.” *American Sociological Review* 35(1): 112–17.
- Saris, Willem E, and Melanie Revilla. 2015. “Correction for Measurement Errors in Survey Research: Necessary and Possible.” *Social Indicators Research* 127(3): 1005–20.

- Schmitt, Neal. 1996. "Uses and Abuses of Coefficient Alpha." *Psychological Assessment* 8(4): 350–53.
- McNeish, Daniel. 2018. "Thanks Coefficient Alpha, We'll Take It from Here." *Psychological Methods* 23(3): 412–33.
- Optional: Savalei, Victoria, and Steven P. Reise. 2019. "Don't Forget the Model in Your Model-Based Reliability Coefficients: A Reply to McNeish (2018)" eds. Simine Vazire and Eiko Fried. *Collabra: Psychology* 5(1): 36.

#### *Applied*

- Achen, Christopher H. 1975. "Mass Political Attitudes and the Survey Response." *The American Political Science Review* 69(4): 1218–31.
- Ansolabehere, Stephen, Jonathan Rodden, and James M Snyder. 2008. "The Strength of Issues: Using Multiple Measures to Gauge Preference Stability, Ideological Constraint, and Issue Voting." *American Political Science Review* 102(02): 215–32.
- Bartels, Larry M. 1993. "Messages Received: The Political Impact of Media Exposure." *American Political Science Review* 87(2): 267–85.

### **October 9: Item Response Theory (IRT): Preliminaries**

Standard error of measurement, IRT models and their assumptions

#### *Technical*

- de Ayala 2022, Ch 2, 5-8
- Kamata, Akihito, and Daniel J Bauer. 2008. "A Note on the Relation Between Factor Analytic and Item Response Theory Models." *Structural Equation Modeling: A Multidisciplinary Journal* 15(1): 136–53.
- Zhou, Xiang. 2019. "Hierarchical Item Response Models for Analyzing Public Opinion." *Political Analysis* 27(4): 481–502.

#### *Applied*

- Cor, M Ken, Edward Haertel, Jon A Krosnick, and Neil Malhotra. 2012. "Improving Ability Measurement in Surveys by Following the Principles of IRT: The Wordsum Vocabulary Test in the General Social Survey." *Social Science Research* 41(5): 1003–16.
- Engelhardt, Andrew M, Stanley Feldman, and Marc J Hetherington. 2023. "Advancing the Measurement of Authoritarianism." *Political Behavior* 45(2): 537–60.
- Optional: Kellstedt, Paul M, Mark D Ramirez, Arnold Vedlitz, and Sammy Zahran. 2019. "Does Political Sophistication Minimize Value Conflict? Evidence from a Heteroskedastic Graded IRT Model of Opinions toward Climate Change." *British Journal of Political Science* 49(4): 1309–32.

### **October 16: IRT: Estimation and Model Fit**

Estimators, person scores, model fit, non-parametric approaches

#### *Technical*

- de Ayala 2022 Ch. 3, 4, 9, & appendices A, B, C
- Choi, Youn-Jeng, and Abdullah Asilkalkan. 2019. "R Packages for Item Response Theory Analysis: Descriptions and Features." *Measurement: Interdisciplinary Research and Perspectives* 17(3): 168–75.

- Duck-Mayr, J Brandon, and Jacob M Montgomery. 2021. “Ends Against the Middle: Measuring Latent Traits When Opposites Respond the Same Way for Antithetical Reasons.” *Political Analysis*: 1–20.
- Optional
  - Bürkner, Paul-Christian. 2021. “Bayesian Item Response Modeling in R with Brms and Stan.” *Journal of Statistical Software* 100: 1–54.
  - Montgomery, Jacob M, and Erin L Rossiter. 2019. “So Many Questions, so Little Time: Integrating Adaptive Inventories into Public Opinion Research.” *Journal of Survey Statistics and Methodology* 40(4): 440–24.
  - Morucci, Marco, Margaret J. Foster, Kaitlyn Webster, So Jin Lee, and David A. Siegel. 2024. “Measurement That Matches Theory: Theory-Driven Identification in Item Response Theory Models.” *American Political Science Review*: 1–19.

#### *Applied*

- Clinton, Joshua, Simon Jackman, and Douglas Rivers. 2004. “The Statistical Analysis of Roll Call Data.” *The American Political Science Review* 98(2): 355–70.
- McGann, Anthony J. 2014. “Estimating the Political Center from Aggregate Data: An Item Response Theory Alternative to the Stimson Dyad Ratios Algorithm.” *Political Analysis* 22: 115–29.
- Pemstein, Daniel, Stephen A. Meserve, and James Melton. 2017. “Democratic Compromise: A Latent Variable Analysis of Ten Measures of Regime Type.” *Political Analysis* 18(4): 426–49.

#### **October 23:** No Class

#### **October 30:** Measurement Models for Non-Random Error

Response biases; multi-trait multi-method; method factors; second-order factors

#### *Technical*

- Marsh, Herbert W, Barbara M Byrne, and Rhonda Craven. 1992. “Overcoming Problems in Confirmatory Factor Analyses of MTMM Data: The Correlated Uniqueness Model and Factorial Invariance.” *Multivariate Behavioral Research* 27(4): 489–507.
- Saris, Willem E., Albert Satorra, and Germà Coenders. 2004. “A New Approach to Evaluating the Quality of Measurement Instruments: The Split-Ballot MTMM Design.” *Sociological Methodology* 34(1): 311–47.
- LaGrange, Beth, and David A. Cole. 2008. “An Expansion of the Trait-State-Occasion Model: Accounting for Shared Method Variance.” *Structural Equation Modeling: A Multidisciplinary Journal* 15(2): 241–71.
- Savalei, Victoria, and Carl F. Falk. 2014. “Recovering Substantive Factor Loadings in the Presence of Acquiescence Bias: A Comparison of Three Approaches.” *Multivariate Behavioral Research* 49(5): 407–24.
- Optional: Castro-Schilo, Laura, Keith F. Widaman, and Kevin J. Grimm. 2013. “Neglect the Structure of Multitrait-Multimethod Data at Your Peril: Implications for Associations With External Variables.” *Structural Equation Modeling: A Multidisciplinary Journal* 20(2): 181–207.

#### *Applied*

- Clifford and Engelhardt. “Acquiescence Bias and Predictive Validity: Problems and Potential Solutions for Agree-Disagree Scales”
- Green, Donald P, Susan Lee Goldman, and Peter Salovey. 1993. “Measurement Error Masks Bipolarity in Affect Ratings.” *Journal of Personality and Social Psychology* 64: 1029–41.
- Green, Donald P, and Jack Citrin. 1994. “Measurement Error and the Structure of Attitudes: Are Positive and Negative Judgments Opposites?” *American Journal of Political Science* 38(1): 256–81.

## **November 6:** Differential Item Functioning and Measurement Equivalence/Invariance

Multi-group analysis; item and test bias

*Technical*

- de Ayala 2022, Ch 12
- Stoetzer, Lukas F., Xiang Zhou, and Marco Steenbergen. 2024. “Causal Inference with Latent Outcomes.” *American Journal of Political Science* n/a(n/a).
- Kline 2023, Ch 22
- Svetina, Dubravka, Leslie Rutkowski, and David Rutkowski. 2019. “Multiple-Group Invariance with Categorical Outcomes Using Updated Guidelines: An Illustration Using Mplus and the Lavaan/semTools Packages.” *Structural Equation Modeling: A Multidisciplinary Journal* 46(1): 1–20.
- Optional:
  - Jorgensen, Terrence D, Benjamin A Kite, Po-Yi Chen, and Stephen D Short. 2018. “Permutation Randomization Methods for Testing Measurement Equivalence and Detecting Differential Item Functioning in Multiple-Group Confirmatory Factor Analysis.” *Psychological Methods* 23(4): 708–28.
  - Oberski, Daniel L, Jeroen K Vermunt, and Guy B D Moors. 2015. “Evaluating Measurement Invariance in Categorical Data Latent Variable Models with the EPC-Interest.” *Political Analysis* 23(4): 550–63.

*Applied*

- Bankert, Alexa, Leonie Huddy, and Martin Rosema. 2017. “Measuring Partisanship as a Social Identity in Multi-Party Systems.” *Political Behavior* 39(1): 103–32.
- Davidov, Eldad. 2009. “Measurement Equivalence of Nationalism and Constructive Patriotism in the ISSP: 34 Countries in a Comparative Perspective.” *Political Analysis* 17(1): 64–82.
- Pérez, Efrén O. 2015. “Mind the Gap: Why Large Group Deficits in Political Knowledge Emerge—And What To Do About Them.” *Political Behavior* 37(4): 933–54.

## **November 13:** Longitudinal Measurement Models

Cross-lagged panel models and their critiques; latent growth models

*Technical*

- Kline 2023, Ch 21
- Hamaker, Ellen L, Rebecca M Kuiper, and Raoul P P P Grasman. 2015. “A Critique of the Cross-Lagged Panel Model.” *Psychological Methods* 20(1): 102–16.
- Ghisletta, Paolo, and John J. McArdle. 2012. “Latent Curve Models and Latent Change Score Models Estimated in R.” *Structural Equation Modeling: A Multidisciplinary Journal* 19(4): 651–82.

- Optional:
  - Hamaker, Ellen L. 2023. “The Within-between Dispute in Cross-Lagged Panel Research and How to Move Forward.” *Psychological Methods*.
  - Muthén, Bengt, and Tihomir Asparouhov. “Beyond Multilevel Regression Modeling: Multilevel Analysis in a General Latent Variable Framework.”

#### *Applied*

- Engelhardt, Andrew, Efrén Pérez et al. Forthcoming. “Testing the Stability and Temporal Order of PoC Identity and PoC Solidarity: New Evidence from a Survey Panel of Asian, Black, Latino, and Multiracial Adults.” *American Journal of Political Science*.
- Satherley, Nicole, Chris G Sibley, and Danny Osborne. 2021. “Ideology before Party: Social Dominance Orientation and Right-wing Authoritarianism Temporally Precede Political Party Support.” *British Journal of Social Psychology* 60(2): 509–23.
- Zubielevitch, Elena, Danny Osborne, Petar Milojev, and Chris G. Sibley. 2023. “Social Dominance Orientation and Right-Wing Authoritarianism across the Adult Lifespan: An Examination of Aging and Cohort Effects.” *Journal of Personality and Social Psychology* 124(3): 544–66.

### **November 20: Mixture Models**

Factor mixture models; latent class and latent profile analysis; latent transition analysis

#### *Technical*

- Weller, Bridget E, Natasha K Bowen, and Sarah J Faubert. 2020. “Latent Class Analysis: A Guide to Best Practice.” *Journal of Black Psychology* 46(4): 287–311.
- Bagozzi, Benjamin E., and Bumba Mukherjee. 2012. “A Mixture Model for Middle Category Inflation in Ordered Survey Responses.” *Political Analysis* 20(3): 369–86.
- Lubke, Gitta H., and Bengt Muthén. 2005. “Investigating Population Heterogeneity With Factor Mixture Models.” *Psychological Methods* 10(1): 21–39.
- Clark, Shaunna L., Bengt Muthén, Jaakko Kaprio, Brian M. D’Onofrio, Richard Viken, and Richard J. Rose. 2013. “Models and Strategies for Factor Mixture Analysis: An Example Concerning the Structure Underlying Psychological Disorders.” *Structural Equation Modeling: A Multidisciplinary Journal* 20(4): 681–703.

#### *Applied*

- Engelhardt, Oelerich, and Pettit. n.d. “Allyship as a Perspective: Clarifying Advantaged Individuals’ Support for Disadvantaged Groups and its Political Connections.”
- Fowler, Anthony, Seth J. Hill, Jeffrey B. Lewis, Chris Tausanovitch, Lynn Vavreck, and Christopher Warshaw. 2023. “Moderates.” *American Political Science Review* 117(2): 643–60.
- Lilly, Kieren J., Thomas H. Costello, Chris G. Sibley, and Danny Osborne. 2024. “Identifying ‘Types’ of Authoritarians: A Latent Profile Analysis of Left- and Right-Wing Authoritarianism and Social Dominance Orientation.” *European Journal of Personality*.

### **December 4**

Project presentations