SOCI/DEMG 612: Categorical Data Analysis

Professor Xi Song

Fall, 2019

[version 9/9/19]

E-mail: xisong@upenn.edu
Office Hours: Friday 11am–1pm
Office: McNeil 271

Web: https://canvas.upenn.edu/courses/1476358
Class Hours: Monday 2–5pm
Class Room: Caster A14
https://xisong-soc612fall2019.youcanbook.me/

Emmanuel Souza
TA Email: efranc@sas.upenn.edu
Lab Room: McNeil 582

Office Hours: Friday, 10–11 am
Lab Hours: Thursday 5–6 pm

Course Overview

This course teaches statistical methods for analyzing categorical data, with an emphasis on practical applications rather than statistical theories. The goal of this course is to teach sociology students to learn from categorical data. The course stresses the use of various statistical methods to explain the phenomena and test models in order to address social science and policy questions, broadly defined. Familiarity with multivariate linear regression models for continuous dependent variables is assumed. Portions of textbooks and selected articles in the current literature will be assigned as Readings. There will also be a weekly tutorial taught by the teaching assistants.

Prerequisites

A prior statistics course—SOCI 536, or the equivalent—is required.

Contacts

You can reach me via email; however, I do not respond to email between 9 pm and 9 am (and neither do the teaching assistant) or over the weekend. If I don't respond within 24 hours, please feel free to send me a polite reminder. I don't intend to be unavailable, but sometimes I get quite a lot of email and/or I simply get swamped. Reminders do not offend me.

I will respond to most of the emails regarding the course, and this is the best way to work through simple questions. Please check your email and Canvas/Piazza several times a week. Email is one of the best ways to keep in touch with our class when we are not in class. More complex questions would likely require more time, and for these, I recommend my office hours.

Textbooks

- **Required**
  1. Long, Scott. 1997. *Regression Models for Categorical and Limited Dependent Variables*. Thousand Oaks, CA: Sage. (Hereafter Long)
  2. Powers, Daniel and Yu Xie. 2008. *Statistical Methods for Categorical Data Analysis*, Second Edition. Howard House, England: Emerald. (Hereafter Powers & Xie)
- **Optional**
  1. Agresti, Alan. 2007. *An Introduction to Categorical Data Analysis*. Wiley.
  2. Agresti, Alan. 2013. *Categorical Data Analysis*. 3rd Edition. Wiley.
  3. Clogg, Clifford C. and Shihadeh, Edward S. 1994. *Statistical Models for Ordinal Variables (Advanced Quantitative Techniques in the Social Sciences)*. Thousand Oaks, CA: Sage.
  4. Fienberg, Stephen E. 1980. *The Analysis of Cross-Classified Categorical Data*. Second Edition. Cambridge, MA: MIT Press.
  5. Hout, Michael. 1983. *Mobility Tables*. Thousand Oaks, CA: Sage.
  6. Treiman, Donald J. 2014. *Quantitative Data Analysis: Doing Social Research to Test Ideas*. John Wiley & Sons.
- **Recommended**
  1. Long, J. Scott. 2009. *The Workflow of Data Analysis using Stata*. Stata Press.
  2. Miller, Jane E. 2005. *The Chicago Guide to Writing about Multivariate Analysis*. University of Chicago Press.

Required Software

- **R**
- **RStudio** is an integrated development environment for **R**, a programming language for statistical computing and graphics.
  - **R** tutorial courses on **DataCamp**
  - More tutorials in TA sessions

Class Requirements and Evaluation

1) Weekly Problem Sets (40% of your final grade)

Problem Sets will be due in class the week after they are assigned on **Monday** at **2** pm. Please submit both a paper copy (hand in to TA) and upload an electronic version to Canvas. Any programming language is accepted for the simulation exercises. **If students have any questions on Problem Sets they should first ask TA and only ask the professor if the TA is unable to help.**

There are **11** assignments in the semester (except for the midterm week and the final week). They will be read and returned the following week on **Mondays**. It is important that you do each set of weekly assignment completely and on time; **late submissions will not be accepted**. If for some reason you do not complete your assignment on time, I encourage you to complete it on your own, but we will not accept it for credit. **To compensate for this strict policy, I will drop the lowest grade you receive on an assignment when we tabulate your overall grade.** In the first few weeks, you will be doing analyses using a major U.S. national sample survey (e.g., NORC's General Social Survey). As the quarter progresses, however, for most of the assignments you will be able to substitute data of your own, focusing on topics that interest you and/or that pertain to your term paper.

2) Midterm Exam (30% of your final grade)

The mid-term exam will take place on **October 21, 2019** (or the next Monday after we finish **Topic 6**) from 2 pm to 5 pm. The exam is open-book.

3) Final Paper (and Term Paper Proposal) (30% of your final grade)

The course will culminate in a term paper on a topic of your choosing in which you will carry out a quantitative analysis of some substantive issue using the technical and analytic skills developed by doing the assignments. It is not uncommon for course term papers to lead to or revise master's papers or chapters of Ph.D. dissertations and/or publications.

With instructor's prior approval, you may write co-authored papers with **no more than two** authors. Both authors must be students in the class. In the case of co-authorship, the paper should detail what each author contributes to the project and include a separate paragraph or document detailing what each author contributed.

Your final term paper will be due at the end of the semester on **December 16, 2019, 5 pm**. Late papers will not be accepted. More information on this project will be distributed over the semester.

Course Policies

During Class

I understand that the electronic recording of notes will be important for class and so computers will be allowed in class. Please refrain from using computers for anything but activities related

to the class. Phones are prohibited as they are rarely useful for anything in the course. Eating and drinking are allowed in class but please refrain from it affecting the course.

After Class

I expect you to spend **3** hours in class and **12** hours after class each week on the course subjects.

Office Hours

The scheduled office hours are on Fridays from 11 am to 1 pm. However, due to my travel schedules, I have to cancel the office hours on **September 20, 27, October 11, November 1, November 22, 29**. For those weeks, I will email the class about my new office hours or you can send me an email to schedule separate meetings.

Policies on Incomplete Grades and Late Assignments

Late assignments will not be accepted. See the policy discussed about weekly problem sets.

Grading Policies

The typical UPenn grading scale will be used. Normally, grading will not be on a curve. You can access your personal grades on the course web page as we move along in the course. Your final course grade will be figured according to the following cutoffs:

A = 94 – 100	C = 73 – 76
A- = 90 – 93	C- = 70 – 72
B+ = 87 – 89	D+ = 67 – 69
B = 83 – 86	D = 63 – 66
B- = 80 – 82	D- = 60 – 62
C+ = 77 – 79	F = 59 and Below

However, if no one receives higher than 90+, I reserve the right to curve the scale dependent on overall class scores at the end of the semester. Any curve will only ever make it easier to obtain a certain letter grade.

A Guide for Emergency & Stress

- If you have an emergency, call 511 or the Division of Public Safety 215-573-3333. Help is available 24/7.
- If you need consultation, call CAPS (Counseling and Psychological Services): 215-898-7021. On call clinicians are available 24/7.
- If you have academic difficulty, please contact me or seek help from the following services:

1. Weingarten Learning Resources Center: Professional instruction in skills such as academic reading, test taking, and study strategies.
2. Tutoring Center: A variety of subject-specific peer tutoring services to supplement support from faculty, TAs, and instructors.
3. Marks Family Writing Center: Provides expert help in writing for undergraduate and graduate students.
4. Language Direct: Provides tutoring for foreign languages.
5. Van Pelt Library: Support for students in research and instructional technologies through a range of workshops and consultations.

Canvas & Piazza

You can download all course materials from the course Canvas website:

https://canvas.upenn.edu/courses/1476358

The Canvas website now integrates features from the **Piazza** forum, which allows students to post questions and communicate with other students in the class.

Plan of Lecture

- Basic Concepts
- The Logit Model for Binary Outcomes
- Simple Models and Association Measures for Two-Way Contingency Tables
- Applications of Loglinear Models to the Study of Intergenerational Mobility Tables
- Models and Association Measures for Multi-Way Tables
- Association Models for Ordinal Variables
- Mid-Term Examination (Open Book)
- Models for Ordinal Dependent Variables
- Multinomial Logit Model
- Tobit Regression for Censoring and Truncation
- Poisson Models for Count Data
- Conditional Logit Model
- Group-Based Trajectory Models
- Sequence Analysis

Class Schedules (Subject to Change)

Topic 1 (September 9): *Basic Concepts*

- Chapter 1 Introduction in Powers & Xie.
- Chapter 2 Review of Linear Regression Models in Powers & Xie.

Topic 2 (September 16): *The Logit Model for Binary Outcomes*

- Chapter 3 Models for Binary Data in Powers & Xie.
- For sociological examples, see Chapter 13 in Treiman

Topic 3 (September 23): *Simple Models and Association Measures for Two-Way Contingency Tables*

- Chapter 4.1–4.4 in Powers & Xie
- For sociological examples, see Chapter 12 in Treiman

Topic 4 (September 30): *Applications of Loglinear Models to the Study of Intergenerational Mobility Tables*

- Duncan, Otis Dudley. 1979. "How Destination Depends on Origin in the Occupational Mobility Table." *American Journal of Sociology* 84:793–803.
- Hauser, Robert M. 1980. "Some Exploratory Methods for Modeling Mobility Tables and Other Cross-Classified Data." Pp. 413–58 in *Sociological Methodology* edited by K. F. Schuessler. San Francisco, CA: Jossey-Bass.
- Hout, Michael. 1983. *Mobility Tables*. Thousand Oaks: CA: Sage (see the optional reading)
- Song, Xi and Robert D. Mare. 2015. "Retrospective Versus Prospective Approaches to the Study of Intergenerational Social Mobility." *Sociological Methods and Research* 44(4): 555–584.

Topic 5 (October 7): *Models and Association Measures for Multi-Way Tables*

- Chapter 4.6 in Powers & Xie
- Mare, Robert D. 1991. "Five Decades of Educational Assortative Mating." *American Sociological Review* 56:15-32.
- Jarvis, Benjamin F., and Xi Song. 2017. "Rising Intragenerational Occupational Mobility in the United States, 1969 to 2011." *American Sociological Review* 82.3 (2017): 568–599.

Topic 6 (October 14): *Association Models for Ordinal Variables*

- Chapter 4.5 in Powers & Xie.
- Clogg, Clifford C. 1982. "Using Association Models in Sociological Research: Some Examples." *American Journal of Sociology* 88(1):114–134.
- Xie, Yu. 1992. "The Log-Multiplicative Layer Effect Model for Comparing Mobility Tables." *American Sociological Review* 57:380–395.

Mid-Term Examination (October 21): *Open Book*

- The exam question answers will be discussed in the next week's class.

Topic 7 (October 28): *Models for Ordinal Dependent Variables*

- Chapter 7 in Powers & Xie
- Chapter 5 in Long
- For sociological examples, see Chapter 14 in Treiman

Topic 8 (November 4): *Multinomial Logit Model*

- Chapter 8.1–8.5 in Powers & Xie
- Chapter 6 in Long
- Anderson, John A. 1984. "Regression and Ordered Categorical Variables." *Journal of the Royal Statistical Society: Series B (Methodological)* 46(1): 1–22.
- Williams, Richard. 2006. "Generalized Ordered Logit/Partial Proportional Odds Models for Ordinal Dependent Variables." *The Stata Journal* 6(1): 58–82.
- For sociological example, see Chapter 14 in Treiman

Topic 9 (November 11): *Tobit Regression*

- Chapter 7 in Long
- suggested papers?

Topic 10 (November 18): *Poisson Models for Count Data*

- Chapter 8 in Long
- Song, Xi, Cameron Campbell, James Z. Lee. 2015. "Ancestry Matters: Patrilineage Growth and Extinction." *American Sociological Review* 80(3): 574–602.

Topic 11 (November 25): *Conditional Logit Model*

- Chapter 8.6–8.7 in Powers & Xie
- Zeng, Zhen, and Yu Xie. 2008. "A Preference-Opportunity-Choice Framework With Applications to Intergroup Friendship." *American Journal of Sociology* 114: 615–648.

Advanced Topic (December 2): *Group-Based Trajectory Models*

- Jones, Bobby L. and Daniel S. Nagin. 2007. "Advances in Group-Based Trajectory Modeling and a SAS Procedure for Estimating Them." *Sociological Methods and Research* 35:542–571.
- Nagin, Daniel S. 2005. *Group-Based Modeling of Development*. Boston, MA: Harvard University Press.
- Song, Xi, Emma Zang, and Kenneth C. Land. "Intergenerational Associations of Income Dynamics: A Dyadic Group-Based Approach." working paper.

Advanced Topic (December 9): *Sequence Analysis*

- Abbott, Andrew. 1990. "A Primer on Sequence Methods." *Organization Science* 1:373–92.
- Abbott, Andrew. 1995. "Sequence Analysis: New Methods for Old Ideas." *Annual Review of Sociology* 21:93–113.
- Abbott, Andrew and John Forrest. 1986. "Optimal Matching Methods for Historical Sequences." *Journal of Interdisciplinary History* 16:471–94.
- Abbott, Andrew and Angela Tsay. 2000. "Sequence Analysis and Optimal Matching Methods in Sociology." *Sociological Methods & Research* 29(1):3-33.
- Aisenbrey, Silke, and Anette E. Fasang. 2010. "New Life for Old Ideas: The 'Second Wave' of Sequence Analysis Bringing the Course Back into the Life Course." *Sociological Methods & Research* 38.3: 420–462.
- Frye, Margaret, and Jenny Trinitapoli. 2015. "Ideals as Anchors for Relationship Experiences." *American Sociological Review* 80(3): 496–525.
- Humphries, John Eric. 2018. "The Causes and Consequences of Self-Employment over the Life Cycle" working paper.

Advanced Topics

If time permits, we will discuss advanced topics on group-based trajectory models and sequence analysis. Students (individuals or groups of students) will discuss a topic in depth for the entire group. The instructor will work with the students in advance of their presentations, reviewing and participating in the formal presentations.

Additional Recommended Readings by Topic (by Jennie Brand)

The following list of readings offers further elaboration or additional topics beyond the Readings. The list provides you with references to pursue as you advance the research design for your term paper or to elaborate on a week's topic. (Note: There may be newer editions to some of these books.)

R

- Healy, Kieran. 2018. *Data Visualization: A Practical Introduction*. Princeton, NJ: Princeton University Press.
- Imai, Kosuke. 2018. *Quantitative Social Science: An Introduction*. Princeton, NJ: Princeton University Press.

Stata

- Kohler, Ulrich and Frauke Kreuter. 2012. *Data Analysis Using Stata*. 3rd Edition. College Station, TX: Stata Press.
- Mitchell, Michael N. 2008. *A Visual Guide to Stata Graphics*. 2nd Edition. Boston: Brooks/Cole.
- Rabe-Hesketh, Sophia, and Brian Everitt. 2007. *A Handbook of Statistical Analyses Using Stata*. 4th edition. Boca Raton, FL: Chapman & Hall/CRC.
- Treiman, Donald J. 2014. *Quantitative Data Analysis: Doing Social Research to Test Ideas*. John Wiley & Sons. [Ample examples from AJS and ASR papers and online Stata codes to replicate the publication results.]

Writing Manuscripts and Making Tables

- Becker, Howard S. 1986. *Writing for Social Scientists: How to Start and Finish Your Thesis, Book, or Article.* Chicago: University of Chicago Press. [From Becker's own work with students on editing papers;]
- Booth, Wayne, Gregory Colomb, and Joseph Williams. 2008. *The Craft of Writing.* Chicago: University of Chicago Press. [Describes how to ask questions, make good arguments, make claims, assemble evidence, communicate your results and argument, and connect with readers;]
- Ebel, Hans F., Claus Bliefert, and William E. Russey. 2004. *The Art of Scientific Writing.* Wiley. [For writing about chemistry and related fields, but nevertheless a useful resource.]
- Strunk, William and E. B. White. 2009. *Elements of Style, 50th Anniversary Edition.* Pearson and Longman. [Classic writing manual–a must have;]
- Williams, Joseph. 2007. *Style: Lessons in Clarity and Grace, 9th Edition.* New York: Pearson Longman. [A wonderful small book on effective writing; I highly recommend this one;]

Regression Analysis and Overviews on Quantitative Analysis

- Berk, Richard. 2004. *Regression Analysis: A Constructive Critique*. Thousand Oaks: Sage.
- Fox, John. 1991. *Regression Diagnostics.* (Sage No. 79)
- Fox, John. 1997. *Applied Regression Analysis, Linear Models, and Related Methods.* Thousand Oaks: Sage.
- Hamilton, Lawrence C. 1992. *Regression with Graphics: A Second Course in Applied Statistics.* Belmont: Duxbury Press. [A useful advanced applied statistics text for Stata users;]
- Jaccard, James, and Robert Turrisi. 2003. *Interaction Effects in Multiple Regression. 2nd ed.* (Sage No. 72)
- Marsh, Lawrence C., and David R. Cormier. 2001. Spline Regression Models. (Sage No. 137)
- Osborne, Jason W. 2008. Best Practices in Quantitative Methods. Los Angeles: Sage Publications.

Logistic Regression and Allied Procedures

- Hosmer, David W., and Stanley Lemeshow. 2000. Applied Logistic Regression. 2nd Edition. New York: Wiley. [A classic text; authors are biostatisticians;]
- Liao, Tim Futing. 1994. Interpreting Probability Models: Logit, Probit, and Other Generalized Linear Models. (Sage No. 101)
- Long, J. Scott, and Jeremy Freese. 2006. Regression Models for Categorical Dependent Variables Using Stata, 2nd Edition. College Station: Stata Press.
- Menard, Scott. 2001. Applied Logistic Regression Analysis. 2nd ed. (Sage No. 106) [A non-technical introduction to logistic regression;]

Log-linear and Log-multiplicative Analysis

- Knoke, David, and Peter Burke. 1980. *Log-Linear Models*. (Sage No. 20.)
- Wong, Raymond Sin-Kwok. 2010. *Association models* (Sage No. 164)

Estimation, Statistical Inference, and Related Topics

- Good, Phillip I. and James W. Hardin. 2012. *Common Errors in Statistics and How to Avoid Them*. Hoboken: John Wiley & Sons.
- Smithson, Michael. 2002. *Confidence Intervals*. (Sage No. 140)

Missing Data

- Allison, Paul D. 2001. *Missing Data*. (Sage No. 136)
- Little, Roderick J. A., and Donald B. Rubin. 2002. *Statistical Analysis with Missing Data*, 2nd ed. New York: John Wiley & Sons. [The definitive treatment, by the creators of multiple-imputation;]

Sample Selection Bias

- Berk, Richard A. 1983. "An Introduction to Sample Selection Bias in Sociological Data." *American Sociological Review* 48:386–98.
- Breen, Richard. 1996. *Regression Models: Censored, Sample Selected, or Truncated Data*. (Sage No. 111)
- Kang Fu, Vincent, Christopher Winship, and Robert D. Mare. 2004. "Sample Selection Bias Models." Pp. 409–430 in *Handbook of Data Analysis*, Melissa Hardy and Alan Bryman, eds., Sage Publications. [An update to the citation below by Winship and Mare]
- Winship, Christopher, and Robert D. Mare. 1992. "Models for Sample Selection Bias." *Annual Review of Sociology* 18:327–50.

Basic Econometrics

- Angrist, Joshua and Jorn-Steffen Pischke. 2009. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton: Princeton University Press.
- Greene, William H. 2008. *Econometric Analysis* 6th Edition. Upper Saddle River, NJ: Prentice Hall.
- Woolridge, Jeffrey M. 2002. *Econometric Analysis of Cross-Section and Panel Data*. Cambridge: The MIT Press.
- Wooldridge, Jeffrey M. 2019. *Introductory Econometrics: A Modern Approach*. 7th edition. Cengage Learning.

Causal Inference

- Elwert, Felix, and Christopher Winship. 2014. "Endogenous Selection Bias: The Problem of Conditioning on a Collider Variable." *Annual Review of Sociology* 40: 31–53.
- Gangl, Markus. 2010. "Causal Inference in Sociological Research." *Annual Review of Sociology* 36:21–47.
- Hong, Guanglei. 2015. *Causality in a Social World: Moderation, Mediation and Spill-over*. John Wiley & Sons.
- Imbens, Guido W., and Donald B. Rubin. 2015. *Causal Inference in Statistics, Social, and Biomedical Sciences*. Cambridge University Press.

- Manski, Charles. 1995. *Identification Problems in the Social Sciences*. Boston, MA: Harvard University Press.
- Morgan, Stephen, ed. 2013. *Handbook of Causal Analysis for Social Research*. Springer Series.
- Morgan, Stephen, and Christopher Winship. 2014. *Counterfactuals and Causal Inference: Methods and Principles for Social Research* Second Edition. New York, NY: Cambridge University Press.
- Pearl, Judea. 2000. *Causality: Models, Reasoning, and Inference*. New York, NY: Cambridge University Press.
- Rosenbaum, Paul. 2010. *Observational Studies*. New York: Springer.
- Rubin, Donald. 2006. *Matched Sampling for Causal Effects*. New York, NY: Cambridge University Press.
- VanderWeele, Tyler. 2015. *Explanation in Causal Inference: Methods for Mediation and Interaction*. Oxford University Press.

Fixed and Random Effects Models

- Allison, Paul. 1990. "Change Scores as Dependent Variables in Regression Analysis." *Sociological Methodology* 20:93–114.
- Allison, Paul. 1994. "Using Panel Data to Estimate the Effects of Events." *Sociological Methods and Research* 23:174–199. Baltagi, Badi H. 2008. *Econometric Analysis of Panel Data* 4th Edition. New York: Wiley.
- Halaby, Charles N. 2004. "Panel Models in Sociological Research: Theory into Practice." *Annual Review of Sociology* 30:507–44. [A nice review, focusing on causal inference and fixed effects models;]
- Hausman, Jerry A. 1978. "Specification Tests in Econometrics." *Econometrica* 46:1251–1272. [Hausman tests are frequently used to compare fixed and random effects models; this article introduces the test;]

Propensity Score Matching

- Abadie, Alberto, David Drukker, Jane Leber Herr, and Guido Imbens. 2002. "Implementing Matching Estimators for Average Treatment Effects in Stata." *Stata Journal*. [A nice Stata routine to use for PS matching.]
- Becker, Sascha O., and Andrea Ichino. 2002. "Estimation of Average Treatment Effects Based on Propensity Scores." *Stata Journal* 2:358–377. [Use this routine to generate p-scores. It also contains matching estimators;]
- Morgan, Stephen and David Harding. 2006. "Matching Estimators of Causal Effects." *Sociological Methods & Research* 35(1):3–60.

- Rosenbaum, Paul R. and Donald B. Rubin. 1984. "Reducing Bias in Observational Studies using Sub-classification on the Propensity Score." *Journal of the American Statistical Association* 79, 516–524.
- Smith, Herbert L. 1997. "Matching with Multiple Controls to Estimate Treatment Effects in Observational Studies." *Sociological Methodology* 27:325–353.

Instrumental Variables

- Angrist, Joshua. D., Guido W. Imbens, and Donald B. Rubin. 1996. "Identification of Causal Effects Using Instrumental Variables." *Journal of the American Statistical Association* 91(434): 444–455.
- Angrist, Joshua and Alan Krueger. 2001. "Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments." *Journal of Economic Perspectives* 15(4): 69–85.
- Heckman, James. 1997. "Instrumental Variables: A Study of Implicit Behavioral Assumptions Used in Making Program Evaluations." *Journal of Human Resources* 32(3): 441–462.
- Imbens, Guido and Joshua Angrist. 1997. "Identification and Estimation of Local Average Treatment Effects." *Econometrica* 62: 467–476.

Event History / Survival Models

- Blossfeld, Hans-Peter, Katrin Golsh, and Gotz Rohwer. 2007. *Event History Analysis with Stata*. London: Lawrence Erlbaum Associates Publishers.
- Allison, Paul D. 2014. *Event History Analysis: Regression for Longitudinal Event Data*. 2nd Edition. (Sage No. 46)
- Hosmer, D.W. and S. Lemeshow. 1999. *Applied Survival Analysis: Regression Modeling of Time to Event Data*. Wiley Series in Probability and Statistics.

Structural Equation Modeling

- Bollen, Kenneth A. 1989. *Structural Equations with Latent Variables*. New York: John Wiley and Sons.
- Duncan, Otis Dudley. 1975. *Introduction to Structural Equation Models*. New York: Academic Press.
- Jöreskog, Karl G., and Sörbom, Dag. 1996. *LISREL 8: User's Reference Guide*. Chicago, IL: Scientific Software International.
- Loehlin, John C. 2004. *Latent Variable Models: An Introduction to Factor, Path, and Structural Analysis*. 4th Edition. Lawrence Erlbaum Associates.

Multilevel Models

- DiPrete, Thomas and Jerry D. Forristal. 1994. "Multilevel Models: Methods and Substance." *Annual Review of Sociology* 20:331–357.
- Rabe-Hesketh and Anders Skrondal. 2008. *Multilevel and Longitudinal Modeling Using Stata 2nd Edition*. College Station, TX: Stata Press.
- Raudenbush, Stephen and Anthony Bryk. 2002. *Hierarchical Linear Models.* Thousand Oaks: Sage.

Growth Curve and Trajectory Models

- Bollen, Kenneth A. and Patrick J. Curran. 2006. *Latent Curve Models: A Structural Equation Perspective.* New York: Wiley.
- Hedeker, Donald, and Robert D. Gibbons. 2006. *Longitudinal Data Analysis*. Vol. 451. John Wiley & Sons.
- Jones, Bobby L. and Daniel S. Nagin. 2007. "Advances in Group-Based Trajectory Modeling and a SAS Procedure for Estimating Them." *Sociological Methods and Research* 35:542–571.
- Nagin, Daniel S. 2005. *Group-Based Modeling of Development.* Boston, MA: Harvard University Press.
- Singer, Judith and John B. Willet. 2003. *Applied Longitudinal Data Analysis.* Oxford: Oxford University Press.

Network Analysis

- Scott, John. 1991. *Social Network Analysis: A Handbook*. London: Sage
- Wasserman, Stanley and Katherine Faust. 1994. *Social Network Analysis: Methods and Applications*. Cambridge: Cambridge University Press.