

Multilevel and Longitudinal Data Analysis

HUDM 6030 001

Spring 2009 Thursday 3:00-4:40, HM234
Instructor: Lawrence T. DeCarlo
Office: Grace Dodge 453h
Office hours: Tues. 3:30-5:00, Thurs. 1:30-3:00, and by appointment
Phone: 212-678-4037 Fax: 212-678-3837
Email: decarlo@tc.edu
Website: <http://www.columbia.edu/~ld208/>

Required Text: *Multilevel analysis: An introduction to basic and advanced multilevel modeling.* (1999). Tom A. B. Snijders & Roel J. Bosker. Thousand Oaks, CA: Sage Publications.

Objectives

Multilevel models include a broad range of models called by various names, such as random coefficient models, hierarchical models, multilevel models, and growth curve models. Multilevel modeling is becoming increasingly popular in educational and psychological research because it allows one to take into account the effects of common contexts shared by people, for example, such as students in the same class. This was often ignored in traditional methods (e.g., regression), which led to erroneous conclusions. A well-known example is discussed on the Internet at the multilevel models homepage (given below) under *An introduction to multilevel models*: An earlier study had concluded that there was an effect of teaching style on elementary school students reading progress, whereas later (multilevel) analysis showed that, when groupings within teachers and classes were taken into account, there was no longer any evidence of an effect of teaching style. This course will illustrate problems associated with ignoring a multilevel structure and show how they can be remedied.

The course will introduce the background and computer skills needed to understand and utilize multilevel models. The objectives are to give students and researchers (a) the knowledge as to when these techniques might be useful, (b) an understanding of the theory and statistics involved in these techniques, (c) limitations of these techniques, (d) an ability to read and criticize published research using these techniques, (e) an overview of current issues and developments. The software HLM5 will be used to analyze multilevel data, and the software Mplus will be used to analyze growth curve models with time varying and time invariant covariates. The use of some other software, such as SAS and Stata, will also be illustrated.

Topics

Expectations, covariance, regression, maximum likelihood estimation, generalized least squares, multilevel regression, and growth curve modeling. You will learn how to diagram the model, write it as a system of equations, write and run HLM and Mplus programs, and interpret the results. Possible advanced topics to be covered are multilevel analysis of categorical data, missing data analysis, latent classes in SEM and growth curve modeling, and non-parametric multilevel models.

Recommended Textbooks

Because of the current popularity of multilevel analysis, many new books have been published on the topic. Following are a selection of books that, in my view, are useful references.

- Beginning:*
- Multilevel analysis: Techniques and Applications.* (2002). Joop Hox
Mahwah, NJ: Lawrence Erlbaum Associates.
- Introducing multilevel modeling.* (1998). Ita Kreft & Jan De Leeuw.
Thousand Oaks, CA: Sage Publications.
- An introduction to multilevel modeling techniques.* (2000). Ronald H.
Heck & Scott, L. Thomas. Mahwah, NJ: Lawrence Erlbaum.
- Intermediate:*
- Hierarchical linear models: Applications and data analysis methods.*
(2nd ed.) (2002). Stephen W. Raudenbush & Anthony S. Bryk. Thousand
Oaks, CA: Sage Publications.
- Applied multilevel analysis.* (1995). Joop J. Hox. This book can be
downloaded from: <http://www.geocities.com/joophox/publist/pubenjh.htm>
- Modeling longitudinal and multilevel data: Practical issues, applied
approaches, and specific examples.* (2000). Todd D. Little, Kai U.
Schnabel, Jürgen Baumert (Eds.). Mahwah, NJ: Lawrence Erlbaum.
- An introduction to latent variable growth curve modeling: Concepts,
issues, and applications.* (1999). Terry E. Duncan, Susan C. Duncan, Lisa
A. Strycker, Fuzhong Li, Anthony Alpert. Mahwah, NJ: Lawrence
Erlbaum.
- Longitudinal data analysis: Designs, models, and methods.* (1998).
Catrien C. J. H. Bijleveld; Leo van der Kamp, Ab Mooijaart, Willem A.
van der Kloot, Rien van der Leeden, Eeke Van Der Burg. Thousand Oaks,
CA: Sage Publications.
- Advanced*
- Multilevel statistical models.* (1995). Harvey Goldstein, London: Arnold
Publishers.
- Multilevel modeling: Methodological advances, issues, and applications.*
(2003). Steven P. Reise & Naihua Duan (Eds.). Mahwah, NJ: Lawrence
Erlbaum Associates.
- Applied*
- Multilevel modelling of health statistics.* A. H. Leyland, H. Goldstein.
New York: John Wiley & Sons.
- Multivariate applications in substance use research.* (2000). Jennifer S.
Rose, Laurie Chassin, Clark C. Presson, Steven J. Sherman (Eds.).
Mahwah, NJ: Lawrence Erlbaum.

For growth curve models, techniques developed in structural equation modeling are useful. There are many textbooks on SEM, here are a few that I think are useful, in order from beginning to advanced:

Principles and practice of structural equation modeling. (1998). Rex B. Kline. New York: New York: Guilford Press.

A Beginner's Guide to Structural Equation Modeling. (1996). Randall E. Schumacker, Richard G. Lomax, Mahwah, NJ: Lawrence Erlbaum Associates.

Advanced Structural Equation Modeling: Issues and Techniques. (1996). George A. Marcoulides, Randall E. Schumacker. Mahwah, NJ: Lawrence Erlbaum Associates.

Structural equation modeling: Foundations and extensions. (2000). David Kaplan. Thousand Oaks, CA: Sage Publications.

Structural Equations with Latent Variables. (1989). Kenneth A. Bollen, New York: John Wiley & Sons.

Software

There are a number of software packages available for multilevel modeling. We will use one of the most popular, HLM, for hierarchical linear models. A student demo version and other information is available from the scientific software international website, www.ssicentral.com. A manual is also available (for purchase):

HLM6: Hierarchical linear and nonlinear modeling. (2004). Stephen W. Raudenbush, Anthony S. Bryk, Yuk Fai Cheong, & Richard Congdon. Lincolnwood IL: Scientific Software International.

We will also be using the software Mplus to fit multivariate latent growth curve models. Mplus offers some state of the art capabilities, such as the ability to fit mixture multivariate growth curves, and it uses a very simple command language. A student version is available at the website: www.statmodel.com. A user's manual is also available (for purchase):

Muthén, L.K. and Muthén, B.O. (1998-2007). *Mplus User's Guide*, 5th edition. Los Angeles, CA: Muthén & Muthén

The website at statmodel.com also provides examples for a number of applications, references to articles discussing technical details, and a discussion list covering various topics of interest.

Other software I might demonstrate include PROC MIXED and the GLIMMIX macro of SAS. I might also illustrate the use of GLLAMM, a procedure available within Stata, to fit a model with non-parametric random coefficients. Go to my website for a link to Stata and a link about its availability to TC and Columbia students.

Multilevel

Multilevel is a discussion group concerned with multilevel modeling. Students should join the listserv and read ongoing discussions (it's a low volume yet highly informative list). There are also archives that can be searched (e.g., by topic, author, etc.). To join the listserv, go to: <http://www.jiscmail.ac.uk/lists/MULTILEVEL.html>, where steps for joining the listserv and searching the archives are given.

Another useful site is the "Centre for multilevel modelling" homepage: <http://www.cmm.bristol.ac.uk>. Here you can get references, publications, links to software, the multilevel modelling newsletter, and some multilevel datasets. I strongly urge students to go online and look at some issues of the newsletter.

A related discussion group of interest is **semnet**, which discusses structural equation modeling. To join or search the archives, go to: <http://bama.ua.edu/archives/semnet.html>

Note: students should primarily *read* the list. You should not post a question to the list without first thoroughly researching the literature, researching the archives for similar questions, and asking me about it.

Journals

Articles on or using multilevel analysis appear in many journals in many disciplines. However, here are a few in particular that regularly publish articles on multilevel techniques and applications:

Psychological Methods

Multivariate Behavioral Research (there is a 1995 special issue on multilevel)

Sociological Methods and Research (#3, 1994, is a special issue on multilevel)

Journal of Educational and Behavioral Statistics

Requirements and Grading

You should be familiar with ordinary regression analysis and have some experience running statistical analysis on a computer. We will have some hands on sessions in the computer lab. Grades will be determined by homework and in-class quizzes, the quizzes will determine 90% of the grade, the homework 10%.

Students with disabilities

The College will make reasonable accommodations for persons with documented disabilities. Students are encouraged to contact the Office of Access and Services for Individuals with Disabilities for information about registration (166 Thorndike Hall). Services are available only to students who are registered and submit appropriate documentation. As your instructor, I am happy to discuss specific needs with you as well.

Incomplete

The grade of Incomplete is to be assigned only when the course attendance requirement has been met but, for reasons satisfactory to the instructor, the granting of a final grade has been postponed because certain course assignments are outstanding. If the outstanding assignments are completed within one calendar year from the date of the close of term in which the grade of Incomplete was received and a final grade submitted, the final grade will be recorded on the permanent transcript, replacing the grade of Incomplete, with a transcript notation indicating the date that the grade of Incomplete was replaced by a final grade.

If the outstanding work is not completed within one calendar year from the date of the close of term in which the grade of Incomplete was received, the grade will remain as a permanent Incomplete on the transcript. In such instances, if the course is a required course or part of an approved program of study, students will be required to re-enroll in the course including repayment of all tuition and fee charges for the new registration and satisfactorily complete all course requirements. If the required course is not offered in subsequent terms, the student should speak with the faculty advisor or Program Coordinator about their options for fulfilling the degree requirement. Doctoral students with six or more credits with grades of Incomplete included on their program of study will not be allowed to sit for the certification exam.