Multilevel Modeling

Information

Instructor
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•Office Hours: Mondays 10:00–11:15AM and by appointment.

Course
•Y650 (Education) & S481/S681 (Statistics), Spring 2008.
•Web Page: `http://www.indiana.edu/~kenkel/courses`.

Time and Location
•Where: W. W. Wright Education Building, Room 1235.
•We will also meet in the computer laboratory, Room 2015, which will be announced in a preceding lecture.
•When: Mondays & Wednesdays from 11:15–12:30.
•Students are expected to attend all classes.

Prerequisites
•Successful completion of a multivariate statistics course.
•A solid understanding of multiple regression and analysis of variance.

Course Description

Many data structures are nested: students nested within classrooms, workers nested within business units, observations nested within individuals, et cetera. Until recently, dealing with nested data structures has been difficult both conceptually and computationally. New models that have been termed multilevel models (also known as hierarchical [non]linear models, mixed effects models, or random coefficient models) lead to separating the lower level effects and the higher level effects explicitly into different parts (e.g., Level 1, Level 2, etc.) of the same overarching model. Such models are designed to avoid "aggregation bias" and to solve the "unit of analysis" problem, all while appropriately accounting for the correlated nature of the "within unit" observations. This course will introduce students to the general multilevel model with an emphasis on applications. We will discuss how such models are conceptualized, the meaning and interpretation of the parameter estimates, and finally how to implement them in computer programs. A major emphasis throughout the course will be on how to choose the appropriate model so that specific questions of interest can be addressed in a methodologically sound way.

Evaluation

Student evaluation will be based on class participation (10%), assignments (written/laboratory) (30%), article summaries and critique (15%), class presentation (15%), and final project (30%).

Although the theoretical and abstract issues surrounding the analysis of nested data structures is an integral part of the course, so too is the application of the methods via computer programs (it is not generally possible to do "hand calculations" for multilevel models). There will be, thought, written, and computer assignments throughout the semester. These assignments are an important part of the course, ensuring that students are grasping the readings, lectures, and laboratory components of the course. An article summary of recent work where multilevel models were used and an article critique (both 5–7 double spaced pages) are required. The summary and critique are helpful to connect the multilevel modeling techniques discussed in class to current applied research. Class presentations are required, where students will present an advanced topic that is not covered in the course or provide an in-depth discussion of a topic briefly covered in the course. The final project will require students to find an appropriate data set (ideally one that is in the public domain and related to his or her area of research), and conduct an appropriate set of analyses to answer an appropriate set of questions of interest. Details for all of the assignments will be posted on the class web page.

The way in which a numeric grade will be determined is governed by the following equation:

$$Grade = .10(Participation)+.30(Assignments)+.15(Summaries\&Critique)+.15(Presentation)+.30(Proje$$

Because numeric grades are reported as ordinal variables represented by letters, the way in which the numeric grade maps onto letter grades will be as follows:

Numeric Score	*Letter Grade*	*Description of Achievement*
≥ 96	A+	Incredible achievement
91–95.99	A	Outstanding achievement
86–90.99	A−	Excellent achievement
81–85.99	B+	Very good achievement
76–80.99	B	Good achievement
71–75.99	B−	Fair achievement
66–70.99	C+	Not wholly satisfactory achievement
61–65.99	C	Marginal achievement
56–60.99	C−	Unsatisfactory achievement
51–55.99	D	Significant lack of achievement
< 51	F	Complete lack of achievement

Tentative Course Schedule

Date	Topic(s)	Reading(s)
	•Welcome •Discuss Syllabus	•Browse through Raudenbush & Bryk (RB)
	•Understanding hierarchical/multilevel data structures •Applications of multilevel models	•RB, Chapter 1
	•Analysis of variance and covariance with random effects •Choosing the location of independent variables	•RB, Chapter 2
	•Meaning and interpretation of parameters •Hypothesis testing •Fixed and Random effects •Model evaluation	•RB, Chapter 3
	•Cross-sectional nested data structures	•RB, Chapter 5
	•Longitudinal data structures	•RB, Chapter 6
	•Multi-center trial data structures	•RB, Chapter 6
	•Three level multilevel models	•RB, Chapter 8
	•Estimation theory for multilevel models	•RB, Chapter 14
	•Missing data issues	•Reading is TBA
	•Error structures for multilevel models	•SW, Chapter 7
	•Extension to more general latent variable models	•Muthén reading
	•Statistical and methodological issues in MLMs	•Reading is TBA
	•Design considerations for nested data structures	•Reading is TBA
	•Class presentations	
	•Epilogue	

References

Required Textbook

Raudenbush, S. W. & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods*. Sage: Thousand Oaks, CA

Suggested Supplemental Text-Book Resources

Pinheiro, J. C. & Bates, D. M. (2000). *Mixed-effects models in S and S-Plus*. Springer: New York, NY

Academic Honesty and Intellectual Integrity

Academic dishonesty of any kind (e.g., cheating, plagiarism, record altering, etc.) will not be tolerated. As stipulated in *General Principles and Policy* section of Indiana University's Academic Handbook (available here: `http://www.indiana.edu/~deanfac/acadhbk/`), academic dishonesty of any kind will be reported.

Syllabus Disclaimer

The information provided on this syllabus is tentative and subject to change. In fact, it will almost certainly change from time to time. Major changes to the syllabus will be noted during lecture.