



PSYC 575 Multilevel Modeling

Units: 4

Term–Day–Time: Fall 2021–Tues & Thurs–10:00-11:50 am

Location: WPH 205

Instructor: Hok Chio (Mark) Lai

Office Hours: Tues 12:00–1:00 pm, and by appointment.

Contact Info: (Email) hokchiol@usc.edu, (Slack) <https://usc.enterprise.slack.com/>.

Timeline for replying to emails: within 48 hours.

IT Help: ITS, Blackboard

Contact Info:

ITS (Email, Monday – Friday, 8:00 A.M. – 6:00 P.M.) consult@usc.edu, (Phone, 24/7/365) 213-740-5555, (Online) ServiceNow Portal

Blackboard (Email, 24/7/365) blackboard@usc.edu, (Online Help) Blackboard Help for Students

Course Description

This is a graduate-level class in statistical methods on multilevel modeling, a popular technique in behavioral and social science research. The course covers topics in multilevel modeling, including two- and three-level hierarchical linear models (HLM), random intercepts and slopes, longitudinal models and growth curve models, and some recent development in multilevel modeling.

The course begins with a brief overview of the ubiquity of multilevel data and the problems of using conventional methods to handle such data. It then transitions to the conceptual and statistical foundations of two-level multilevel models. Students will learn from different real data examples, and perform analyses using data of their own or provided by the instructor. Later material covers the use of multilevel modeling as a general framework for longitudinal data analysis, and other modeling considerations such as categorical data, non-hierarchical (e.g., cross-classified) data structure, and study designs. Students are also encouraged to provide input in suggesting topics to be covered for this course.

Learning Objectives

After the successful completion of this course, students will be able to . . .

1. Explain the problems of analyzing clustered data with multiple regression/ANOVA;
2. Identify the types of multilevel data structure in different research scenarios;
3. Describe the statistical and conceptual foundations of multilevel modeling;
4. Independently analyze real data using statistical software for multilevel modeling;
5. Evaluate published research that uses multilevel modeling;
6. Apply multilevel modeling in a research project, and effectively communicate findings/products in an oral research presentation or a written research report.

Prerequisite(s): None

Co-Requisite(s): None

Concurrent Enrollment: None

Recommended Preparation: PSYC 503: Regression and the General Linear Model (or a similar regression class); Experience with statistical software (preferably R)

Course Notes

This class will be fully online and will follow a flipped course design. The benefit of a flipped course model is that the lecturer can spend more time with students to go through applications of concepts and hands-on exercises of data analyses.

The lecture videos and course materials will be available at by 9:00 am of each Monday, and students are expected to review these materials and the assigned readings on their own. Please note that the lecture slides only serve to guide class discussions and cannot replace the assigned readings.

Except for Week 1, the **Tuesday meetings** will be optional **Q&A sessions** where students can bring their questions so that the instructor and the class can discuss unclear concepts. During the **mandatory Thursday meetings**, students will work on quizzes, in-class exercises, and discuss questions regarding the learning materials and homework assignments. **Students are expected to have reviewed the posted materials for that week before attending that week's group exercise session.**

Before attending the Thursday sessions, students are expected to have

1. Completed the assigned readings and reviewed the posted videos.
2. Identified questions that come up in their learning.
3. Started working on the homework problems.

Communication

To promote independence and critical thinking, students are encouraged to work through the following process for obtaining answers to course-related questions before contacting the instructor:

- consult the course syllabus;
- consult a classmate or post your questions on Slack;
- meet with the instructor during office hours or Q&A sessions on Tuesdays;
- for personal questions, email the instructor at hokchiol@usc.edu

Technological Proficiency and Hardware/Software Required

- R and RStudio are needed to complete the course assignments. It is highly recommended that students update to the latest versions of both software (R 4.1.0, RStudio 1.4.10XX, or above). We will discuss how to set up R and RStudio in Week 1.
- Stable internet connection (for reviewing lecture videos)

USC technology rental program

If you need resources to successfully participate in your classes, such as a laptop or internet hotspot, you may be eligible for the university's equipment rental program. To apply, please submit an application.

USC Technology Support Links

Blackboard help for students
Slack information for students
Software available to USC Campus

Recommended Materials

- Snijders, T. A. B., & Bosker, R. J. (2012). *Multilevel analysis: An introduction to basic and advanced multilevel modeling* (2nd ed.). Thousand Oaks, CA: Sage.
- (Alternative text) Hox, J. J., Moerbeek, M., & van de Schoot, R. (2018). *Multilevel analysis: Techniques and Applications* (3rd ed.). New York, NY: Routledge.
- Other required readings will be posted on Slack

Optional Materials

- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: applications and data analysis methods* (2nd ed.). Thousand Oaks, CA: Sage.
- Gelman, A., & Hill, J. (2006). *Data analysis using regression and multilevel/hierarchical models*. Cambridge, UK: Cambridge University Press.
- Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence*. Oxford, UK: Oxford University Press. [For longitudinal data analysis]
- West B. T., Welch, K. B., & Galecki, A. T. (2014). *Linear mixed models: A practical guide using statistical software* (2nd ed.). Boca Raton, FL: CRC. [A reference for using different software]
- Galecki, A. T., & Burzykowski, T. (2013). *Linear mixed-effects models using R: A step-by-step approach*. Springer.
- Luke, D. A. (2020). *Multilevel modeling* (2nd ed.). Sage.
- Heck, R. H., Thomas, S. L., & Tabata, L. N. (2014). *Multilevel and longitudinal modeling with IBM SPSS* (2nd ed.). New York, NY: Routledge. [A reference for SPSS users]

Description and Assessment of Assignments

1. In-class exercises (10%). During the Thursday sessions, students will participate in group exercises. If students miss a session for any reason, they can complete the exercise posted on Blackboard within 36 hours (i.e., Friday by end of day, Pacific Time) to get credits.
2. Homework problems (60%). There will be 10 homework assignments for students to apply the concepts and techniques discussed in class to analytic problems. The assignments typically involve performing data analyses using data sets of your own or provided by the instructor, and interpreting the results with some guided questions.
You must submit your work electronically to Blackboard by **Friday 11:59 p.m. Pacific Time** on the assigned due date. See policy on late work.
3. Final project (30%: 5% prospectus, 5% peer review, 20% presentation/final paper). You will complete a research project related to multilevel modeling, typically a research report of an empirical study using real data or a theoretical/methodological paper about certain aspects of multilevel modeling. Students interested in other project ideas (e.g., software package development) should discuss their ideas with the instructor. Each student can choose to work on their own or in a group of up to three people. Each student/group will schedule an appointment with the instructor to talk about their project during week 8 (October 5–9).

There are three grading components for your final project:

- Prospectus (5%)
A prospectus about your project should be submitted by **Monday, October 11, 9:00 a.m. Pacific Time**. The prospectus should contain a concise description of what you (or your group) plan to do for your project, including a preliminary plan for statistical analysis. The prospectus should be limited to 1 single-spaced page (excluding tables, figures, references, and other supplemental materials).
- Peer Review (5%)
After the individual meeting with the instructor, each individual/group will refine their research questions and post a summary of their research questions and preliminary analyses to the dedicated forum on the Discussion Board by **Friday, November 5**. Each student will then give specific comments to the summaries of two other students/groups by **Monday, November 15**. More information on what feedback to give will be included in the grading rubric.
- Final Presentation/Paper (20%)
If you choose to do a presentation, on **November 30 or December 2**, you or your group will give a 20-minute presentation (including Q&A) on your project. The final presentation should include the following four sections: introduction, method, results, and discussion; for methodological or theoretical work, students should follow organizations that are typical in previous papers in their areas of research. **More emphasis should be put on describing the technical details of the analysis and the interpretations of the results.** You will also need to submit your slides to Blackboard for grading **on the day of your presentation**, which should include a link to the reproducible codes for your analyses. A grading rubric on the research presentation will be posted on Blackboard.
If you choose to do a final paper, your paper will be due **Tuesday, December 9, at 1:00 p.m. Pacific Time** (the assigned final exam time for the class). The final paper should include four sections: introduction, method, results, and discussion, or comparable sections; however, **more emphasis should be put on describing the technical details of the analysis and the interpretations of the results.** There should also be a link to the reproducible codes for your analyses. The final paper should be 8-15 double-spaced pages of text (i.e., excluding title page, abstract, references, tables, figures, and appendices).

Participation

Participation accounts for 10% of the course grade. To earn full credit for participation, students should complete and turn in all in-class exercises.

Grading Breakdown

Assignment	% of Grade
In-class exercises	10
Homework 1-9	60
Prospectus	5
Peer Review	5
Final Presentation/Paper	20
TOTAL	100

Grading Scale

Course final grades will be determined using the following scale

A	93-100
A-	89-92
B+	85-88
B	81-84
B-	77-80
C+	73-76
C	70-72
C-	Below 70 (failing)

Assignment Submission

The assignments should be submitted through Blackboard by Friday at 11:59 p.m. Pacific Time, before the class starts.

Grading Timeline

Generally, all graded work will be returned no later than one week from the submission deadline. However, given the high number of students in the class, the instructor may only grade selected questions in each assignment. Solutions will be posted so that students can check their own work.

Late work

Late work will be penalized by a 10% deduction in the assignment grade every 24 hours late unless due to an emergency excused by the instructor. Email the instructor as soon as possible to discuss alternate arrangements due to an emergency.

Technology in the classroom

Phones

Your phone should be turned off or in silent mode (not on vibrate), and should not be used in the classroom.

Tablets and Laptops

During lecture time in the classroom, students can use tablets and laptops only for purposes of viewing course materials and taking notes. Use of tablets and laptops for note taking is strongly discouraged as it may distract both yourself and your peers (Sana, Weston, & Cepeda, 2013). During the in-class exercises, students should use their laptops to complete the assignments.

Attendance

Students are expected to attend all Thursday class sessions on time. If they miss a session, they should complete the class exercises and turn in their work within the timeframe specified in Description and Assessment of Assignments.

Classroom Norms

From USC's FALL 2021 GUIDE: Return To Campus Protocols document,

Students, faculty and staff need to be aware of COVID-19 symptoms, and are required to complete a daily self-screening via Trojan Check before coming onto campus or leaving their on-campus residence.

Students, faculty, and staff are required to wear masks indoors, including classrooms – and no food or drink is permitted during class

The following applies to both in-person and online communications (e.g., Slack discussions and email communications)

- Respect each other's views.
- In written communication messages, make sure they are something you could say to someone to their face.
- Recognize and/or remember that we have different backgrounds.
- Criticize ideas, not individuals or groups.
- Either support statements with evidence, or speak from personal experience.

COVID-19 Guidance

Students should consult the latest COVID-19 testing and health protocol requirements for on-campus courses. Continuously updated requirements can be found on the USC COVID-19 resource center website at <https://coronavirus.usc.edu/> and <https://we-are.usc.edu/>.

Course Evaluation

Student feedback is essential to the instructor and the Department to keep improving this course. Students are encouraged to share their feedback and suggestions in an early-term feedback survey around week 4 to 5, and respond to the standard USC course evaluation survey at the end of the semester.

(Tentative) Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Readings	Assignment Dates
Week 1 Aug 24 & 26	<ul style="list-style-type: none">• Overview of Multilevel Models	<ul style="list-style-type: none">• SB ch 1, 2• R Markdown Intro• Markdown Quick Reference	<ul style="list-style-type: none">• Exercise: R Markdown• HW 1• Quiz on Regression
Week 2 Aug 31 & Sep 2	<ul style="list-style-type: none">• R Markdown• What are Statistical Models?• Review of Regression	<ul style="list-style-type: none">• Gelman et al. ch 1.1, 1.2, 1.4• Gelman et al. ch 4.1, 4.2, 4.4, 4.5• 10 quick tips to improve your regression modeling	<ul style="list-style-type: none">• Exercise: Interpreting interactions• HW 2
Week 3 Sep 7 & 9	<ul style="list-style-type: none">• The Random Intercept Model	<ul style="list-style-type: none">• SB ch 3.1–3.4, 4.1–4.5, 4.8	<ul style="list-style-type: none">• Exercise: Empirical Bayes estimates• HW 3

	Topics/Daily Activities	Readings	Assignment Dates
Week 4 Sep 14 & 16	<ul style="list-style-type: none"> • Effect Decomposition • Random Coefficient Model • Cross-level Interactions 	<ul style="list-style-type: none"> • SB ch 4.6, 5.1–5.3 	<ul style="list-style-type: none"> • Exercise: Effect decomposition • HW 4
Week 5 Sep 21 & 23	<ul style="list-style-type: none"> • Model Estimation • Model Testing • Reporting Results 	<ul style="list-style-type: none"> • SB ch 4.7, 6 	<ul style="list-style-type: none"> • Exercise: Maximum likelihood estimation (MLE) • HW 5
Week 6 Sep 28 & 30	<ul style="list-style-type: none"> • Model Assumptions and Diagnostics 	<ul style="list-style-type: none"> • SB ch 10 	<ul style="list-style-type: none"> • Exercise: TBD • HW 6
Week 7 Oct 5 & 7	<ul style="list-style-type: none"> • MLM for Experimental Designs • Cross-classified Models 	<ul style="list-style-type: none"> • SB ch 13.1 • Hoffman & Rovine (2007) 	<ul style="list-style-type: none"> • Exercise: Identifying data structure • HW 7
Week 8 Oct 12 & 14 (Fall recess)	<ul style="list-style-type: none"> • Models for Longitudinal Data I 	<ul style="list-style-type: none"> • SB ch 15 	
Week 9 Oct 19 & 21	<ul style="list-style-type: none"> • Using GitHub • Models for Longitudinal Data II 	<ul style="list-style-type: none"> • Hoffman (2014) ch 8 	<ul style="list-style-type: none"> • Exercise: Autoregressive and lagged effects • HW 8 • Prospectus (due Oct 25)
Week 10 Oct 26 & 28	Individual meeting on final research project		
Week 11 Nov 2 & 4	<ul style="list-style-type: none"> • Predictive Modeling 	<ul style="list-style-type: none"> • Yarkoni & Westfall (2017) 	<ul style="list-style-type: none"> • Exercise: Model averaging • Post draft for peer review
Week 12 Nov 9 & 11	<ul style="list-style-type: none"> • Multilevel logistic regression • Discrete outcomes 	<ul style="list-style-type: none"> • SB ch 17 	<ul style="list-style-type: none"> • Exercise: Probability vs. odds ratio • HW 9 • Peer review (due Nov 15)
Week 13 Nov 16 & 18	<ul style="list-style-type: none"> • Sample size planning 	<ul style="list-style-type: none"> • SB ch 11 	<ul style="list-style-type: none"> • Exercise: Required sample size • HW 10
Week 14 Nov 23 & 25 (Thanksgiving)	<ul style="list-style-type: none"> • Missing Data 	<ul style="list-style-type: none"> • SB ch 9 • TBD 	
Week 15 Nov 30 & Dec 2 FINAL	Final Presentation		<ul style="list-style-type: none"> • Upload slides (on presentation day) • Final paper (due Dec 9, 1:00 pm)

SB = Snijders & Bosker (2012)

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism—presenting someone else’s ideas as your own, either verbatim or recast in your own words—is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours - 24/7 on call
studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | *Title IX* - (213) 821-8298
equity.usc.edu, titleix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symplcity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776
dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention - (213) 821-4710
campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101
diversity.usc.edu

Information on events, programs and training, the Provost’s Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call
dps.usc.edu

Non-emergency assistance or information.