Stat 414 – Multilevel and Mixed Modelling

Instructor: Beth Chance
Class Time: M-R 10:10-11am, 180-272#
Office: Faculty Office Building East 25-235
Phone: 756-2961 (×62961 on campus)
Email: bchance@calpoly.edu   (a very good way to reach me)
Office Hours: T 1:00-2:00pm, W 11:00-12pm, R 1-2pm, 7-8pm (Zoom), or by appointment,
         email, any time my office door is open.
         See also a Calendly appointment link in Canvas.
Course Webpages: Canvas (http://my.calpoly.edu), Lecture Notes
Course Listserv: stat-414-01-2238@calpoly.edu
Discord server: https://discord.gg/hDrJKgVR

Pre-requisite: Successful completion of STAT 324 or STAT 334 or STAT 524

Course Overview: Overview of multilevel and mixed models, including hierarchical data, intraclass correlation, fixed vs. random coefficients, variance components, comparisons to traditional analyses. Use of R for implementation of methods. 4 lectures

Texts/Materials:
Required:
- *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling (2nd edition)*, Snijders & Bosker, Sage Publishing
- Additional course notes supplied by the instructor

Additional Recommended References: (See discussion in Canvas)
- Gelman, A., & Hill, J. (2007). *Data Analysis Using Regression and Multilevel/ Hierarchical Models*, Cambridge University Press.
- Raudenbush, S., & Bryk, A. (2002) *Hierarchical Linear Models* (2nd ed.). Thousand Oaks, CA: Sage.
- Hox, J. (2002). *Multilevel Analysis: Techniques and Applications*. Mahwah, NJ: Erlbaum.
- Bickel, R. (2007) *Multilevel Analysis for Applied Research: It's Just Regression*. Guilford Press.

You will need out-of-class access to the R statistical package (preferably with RStudio). PowerPoint slides and handouts will be available on the course web pages. You should also have a scientific calculator.

Grading:

Participation	5%
Homework	15%
Project	15%
Quizzes	5%
Exams	15%, 20%, 25% (final)

         Target dates: 10/10, 11/14; Final: Wednesday 10:10am-1pm

Coursework:

- *Participation* will be a subject score based on your class participation, attendance, asking and responding to questions in and outside of class.
- *Quizzes* are intended to review big ideas and will be taken outside of class between class sessions. You will be allowed multiple attempts on many quizzes and to drop lowest score.
- *Homework problems* will be assigned roughly once per week. You will generally have one week to complete the assignments. Assignments should take roughly 4 hours/week. The intention is for you to work on this assignment throughout the week. You are strongly encouraged to ask questions on the assignment in the course discussion board(s). If you wait until the evening before, you will not have enough time to complete the assignment. You are encouraged to work with other people in the class and to submit questions to the course alias/discussion board, **but the work you turn in must be written up individually**. If I determine write-ups are too similar, the score will be divided among the matching papers. No late homework assignments will be accepted. You will be allowed to drop your lowest homework grade. Solutions will be posted online.
- There will be a *data analysis project*. You may work in groups of 1-3 people. The purpose of the project is to give you an opportunity to apply what you have learned in this class to your research area. You can use data you have collected or gathered from a reliable source. Reports will be graded on quality of statistical analysis as well as presentation of results and appropriateness of interpretations and conclusions. You should anticipate being asked to give an oral presentation at the end of the course.
- There will be two in class exams and one comprehensive final.

Advice:
1. Ask questions.
2. Participate in discussions.
3. Review your notes often.
4. Check the course webpage and email list regularly.
5. Start the assignments early.
6. Take the course seriously.
7. Have fun with the material.
8. Think!

Above all, you are responsible for your own learning. As your instructor, my role is providing you with contexts and opportunities to facilitate the learning process. Please call on me to help you with this learning in whatever ways I can.

Academic Integrity
The University Code of Academic Integrity is central to the ideals that undergird this course. Students are expected to be independently familiar with the Code and to recognize that their work in the course is to be their own original work that truthfully represents the time and effort applied. Violations of the Code are most serious and will be handled in a manner that fully represents the extent of the Code and that befits the seriousness of its violation. You and your student peers must have a strong commitment to personal and professional integrity that informs your behavior both before and after graduation, discouraging you from creating a false appearance of achievement by presenting the work of others as your own, or bending or breaking the rules of any situation. This includes the unauthorized use and sharing of information/course resources on the internet.

COVID-19 Compliance, Classroom, and Campus Safety
Cal Poly is committed to protecting the health and safety of the campus community. Taking preventative steps, as well as monitoring your health and staying home if you are feeling unwell, will help protect the entire Cal Poly community. By participating in this course, you agree to abide by all campus safety protocols. Please note that safety protocols may change throughout the quarter. This includes always properly wearing a face covering in the classroom, regardless of vaccination status. You may also wish to bring in your own device for computer work.

Support
If you face emotional or economic challenges this quarter, you are not alone, and Cal Poly can help during this time of crisis. For example:
- Cal Poly's Basic Needs initiative: basicneeds.calpoly.edu
- Student Care Resources: https://coronavirus.calpoly.edu/student-care-resources
- Cal Poly Coronavirus website: http://coronavirus.calpoly.edu/
- Disability Resource Center: drc@calpoly.edu
- Cal Poly's Counseling Services (805-756-2511)

If I can help you in any way to access the resources above, or if you have any questions about student care resources, please let me know, including textbook access.

Responsibilities
Through classroom discussion and online communication, I welcome individuals of all ages, backgrounds, beliefs, races, ethnicities, social classes, genders, gender identities, gender expressions, national origins, documentation statuses, religious affiliations, sexual orientations, abilities – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful and inclusive environment for every other member of the class. This does not mean we cannot disagree or have different ideas. It does mean we try to consider perspectives other than our own, though they may differ from our own beliefs/experiences. If you experience disrespect or discrimination in this class, please report your experiences to me or the Statistics Department chair (aschaffn@calpoly.edu).

Fall, 2023

Tentative Schedule

	Day	Date	Read	Topic	Due
0		9/21	Ch. 2	What is multilevel data	
1	M	9/25		Regression models	Quiz 0
2	T	9/26		Basic regression assumptions	Quiz 1
3	W	9/27		Inference for regression models	Quiz 2
4	R	9/28		Categorical variables	Quiz 3, F: HW 1
5	M	10/2		Interactions	Quiz 4
6	T	10/3		Unequal variances	Quiz 5
7	W	10/4		HC Standard errors	Quiz 6
8	R	10/5			Quiz 7, F: HW 2
	M	10/9		**Review**	
	T	10/10		**Exam 1**	
9	W	10/11	Ch. 3	Between vs. Within associations	
10	R	10/12		Maximum likelihood estimation	Project Proposal
11	M	10/16		Likelihood ratio tests	
12	T	10/17		Random effects	
13	W	10/18		Random intercept models	
14	R	10/19		Shrinkage estimation	F: HW 3
15	M	10/23	Ch. 4	Multilevel models	
16	T	10/24	Ch. 10	Model diagnostics	
17	W	10/25		Influential observations	
18	R	10/26	4.5, 4.6	Level 2 variables	F: HW 4
19	M	10/30	5.1	Random slopes	Project Report 2
20	T	10/31		Random slopes cont.	
21	W	11/1		Example	
22	R	11/2		Modeling heterogeneity	F: HW 5
23	M	11/6	5.5	Three-level models	
24	T	11/7			
25	W	11/8		Case study	
26	R	11/9		Case study	F: HW 6
	M	11/13		**Review**	
	T	11/14		**Exam 2**	
27	W	11/15	Ch. 13	Non-hierarchical models	
28	R	11/16		*Guest speaker*	Project Report 3
		11/20		**Happy Thanksgiving!**	
29	M	11/27	Ch. 14	Multilevel logistic regression	
30	T	11/28			
31	W	11/29	Ch. 15	Longitudinal data	
32	R	11/30			F: HW 7
33	M	12/4		*Guest speaker*	
	T	12/5		Presentations	
	W	12/6		Presentations	
	R	12/7		Review	Final Reports
Final Exam: Wednesday 10:10-1pm					

Fall, 2023

Week	Day	Reading	Topics	HW Due
1 T	9/21	PC Ch. 3	REVIEW of Linear Regression Model Transformations, Residual plots, Multicollinearity	Init surveys
R	9/23	Ch. 4	Categorical variables, ANOVA Guest speaker	F: HW 1
2 T	9/28	Ch. 5	REVIEW Multiple regression, MSE Interactions, Predictions	
R	9/30		Modelling variances Maximum likelihood estimation	F: HW 2
3 T	10/5	Ch. 11	REVIEW adjusted associations, aggregation ML and REML estimation	Project proposals
R	10/7		Within group vs. Between group regression Fixed vs. Random effects	F: HW 3
4 T	10/12	Ch. 12	Variances and Covariances/Correlation Shrinkage	
R	10/14		Random and Fixed effects	F: HW 4
5 T	10/19		Review, **Exam 1**	
R	10/21		Three-level models	
6 T	10/26	Ch. 13	Random slopes	
R	10/28			F: HW 5
7 T	11/2		Model building	
R	11/4		Longitudinal data	
8 T	11/9		Review, **Exam 2**	
R	11/11		**No Class Meeting**	F: HW 7
9 T	11/16	Ch. 14	Logistic regression	
R	11/18			
T	11/23		**Happy Thanksgiving!**	
R	11/25			
10 T	11/30		Non-hierarchical models	
R	12/2		Case study, Project work	F: HW 8
			Final report	
Final Exam: Thursday Dec. 9, 1:10-4pm				