

Fall, 2024

## Stat 414 – Multilevel and Mixed Modelling

**Instructor:** Beth Chance

**Class Time:** M, W 8:10-10:00 am, 186-C102#

**Office:** Faculty Office Building East 25-235

**Phone:** 756-2961 (×62961 on campus)

**Email:** [bchance@calpoly.edu](mailto:bchance@calpoly.edu) (a very good way to reach me)

**Office Hours:** T 9-10am, 2:30-3:30pm, W 11:00-12pm, R 9-10, 2:30-3:30, 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-414-01-2248@calpoly.edu](mailto:stat-414-01-2248@calpoly.edu)

**Discord server:** <https://discord.gg/6prYUU4rx7>

**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 software for implementation of methods. 4 lectures

### Texts/Materials:

#### Required:

- *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling (2<sup>nd</sup> 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). I also hope to run some models in JMP, Minitab, and SAS. PowerPoint slides and handouts will be available on the course web pages. You should also have a scientific calculator.

### Grading:

Participation	10%
Homework/computer problems	25%
Quizzes	5%
Project	15%
Exams	20%, 25% (final)

Target dates: 10/21; Final: Monday 7:10am-10am

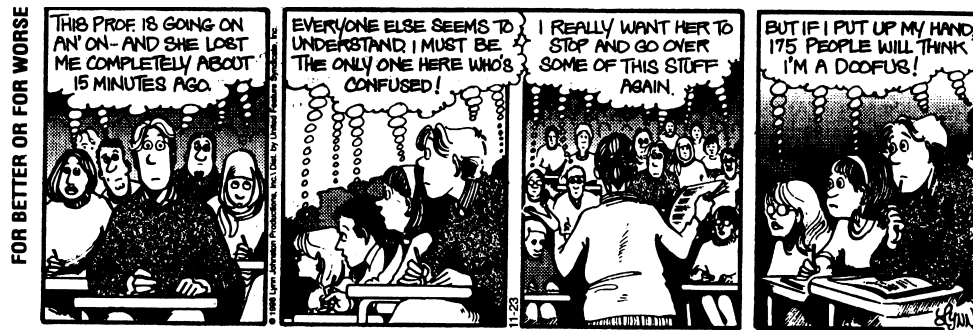
### Coursework:

- *Participation* will be a subject score based on your class participation, attendance, asking and responding to questions in and outside of class. You are encouraged to bring a laptop with you to each class session.
- *Computer problems* will involve finishing a handout from class and submitting your output/discussion before the next class period. You are encouraged to submit with a partner.
- *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. You are allowed to consult an AI program *for programming help only*, **the interpretations you submit must be your own**. No late homework assignments will be accepted. You will be allowed to drop your lowest homework grade. Solutions will be posted online.
- *Quizzes* are intended to review big ideas and will be taken in and/or outside of class between class sessions. Most allow two attempts, keeping the highest score. You should complete all quizzes individually, with no outside human or non-human assistance.
- 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 one 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](http://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](mailto: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,

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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](mailto:aschaffn@calpoly.edu)).

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### Tentative Schedule

Day	Date	Read	Topic	To Do
		Ch. 2	What is multilevel data	Quiz 1
M	9/23		Regression models	
		Ch. 3	Least squares vs. MLE	CP 1
W	9/25		Basic regression assumptions Inference for regression models	Quiz 2 CP 2, F: HW 1
M	9/30		Unequal variances HC Standard errors	
W	10/2		Categorical variables	F: HW 2
M	10/7		Adjusting for other variables Between vs. Within associations	
W	10/9		Random effects Shrinkage estimation	<a href="#">Project Proposal</a> F: HW 3
M	10/14	Ch. 4	Random intercept models Likelihood ratio tests	
W	10/16	4.5, 4.6	Level 2 variables	F: HW 4
M	10/21		<b>Review</b> <b>Midterm exam</b>	
W	10/23		Interactions	F: HW 5
M	10/28	5.1	Random slopes Random slopes cont.	<a href="#">Project Report 2</a>
W	10/30		Modeling Heteroscedasticity	F: HW 6
M	11/4		<b>Veteran's Day</b> Three-level models	
W	11/6	5.5	<a href="#">Guest speaker</a>	<a href="#">Project Report 3</a>
M	11/11	Ch. 10	Model diagnostics Influential observations	
W	11/13	Ch. 13	Non-hierarchical models	F: HW 7
M	11/18	Ch. 14	Multilevel logistic regression	
W	11/20	Ch. 15	Longitudinal data	F: HW 8
	<b>11/25</b>		<b>Happy Thanksgiving!</b>	
M	12/4		<a href="#">Guest speaker</a> Presentations	
W	12/6		Presentations Review	<a href="#">Final Reports</a>
M	12/11		Final exam (7:10-10am)	