Course Syllabus

STAT3530 Applied Linear Models

Fall 2026

Linear models permeate statistics. They provide a foundation for applications ranging from modeling observational data to inference in designed experiments to spatial statistics and time series analysis to predictive modeling and more. This course is an introduction to linear models covering standard topics in model specification, estimation, inference, diagnostics, transformations, and several important extensions.

Instructor: Trevor Ruiz (he/him) [email]

Class meetings: TR 12:00pm–1:50pm in 180-272

Office hours: TR 2:30pm–4:00pm in 25-236

Final project due: Thursday 12/17/26 3:30pm

Catalog description: Linear models in algebraic and matrix form, diagnostics, transformations, polynomial models, categorical predictors, model selection, correlated errors, and logistic regression. Course may be offered in classroom-based, online, or hybrid format. 4 lectures. *Not open to students with credit in STAT 324 or STAT 3430. Prerequisite: One of the following: STAT 252, STAT 1220, STAT 312, STAT 3210, STAT 302, or STAT 3520; and one of the following: MATH 206, MATH 1151, MATH 244, or MATH 2341. Formerly STAT 334.*

Assumed background: I'll assume you are comfortable with the content of an introductory methods course—one- and two-sample inference, ANOVA, and simple linear regression—and with basic matrix algebra and operations, including matrix products, transposition, determinants, and inversion. We'll review matrix concepts as needed along the way. Prior experience with R is helpful but not assumed.

Recommended textbook: Fox, J. (2016). *Applied regression analysis and generalized linear models*, 3rd edition. Sage.

Software: R and RStudio. I will provide a web-hosted environment via posit.cloud that you can access for $5/month; use this [access link] and follow instructions to create an account. I recommend also maintaining a local install; I will provide downloadable copies of project files.

Learning outcomes:

- [L1] Analyze data using linear models and correctly interpret the results.
- [L2] Assess the validity of model results.
- [L3] Compare different models (including those with transformations, categorical predictors, interactions, and polynomials) and select the best model to describe the data.
- [L4] Create a report to describe the results of a linear model to a non-statistician.
- [L5] Apply matrix algebra to the formulation of linear regression and analysis of variance models.
- [L6] Analyze data using the logistic regression model and correctly interpret the results.
- [L7] Formulate matrices for linear contrasts of model coefficients, estimate contrasts, and interpret their results.
- [L8] Describe the vector geometry of a linear model and how it relates to the algebraic expression of the model.
- [L9] Estimate linear and nonlinear functions of regression coefficients using the bootstrap procedure.

Assessments

- **Homeworks (10%).** Homeworks will be given approximately weekly and will be due on Thursdays. These are your opportunities to practice concepts and applications of the material we cover in class.
- **Midterm exams (60%).** Three in-class midterms will be given, each worth 20% of the final grade. These are open-note written exams that do not require the use of software. I will provide study guides one week in advance to help you prepare.
- **Final project (30%).** In place of a cumulative final, you will complete a project with a partner in which you will be expected to carry out an analysis of a real dataset using an appropriately-specified linear model and submit a short report, not to exceed three pages, written for a non-statistician. You can (but are not required to) append a technical supplement of up to five pages; the supplement cannot be used to augment the analysis, and must only contain supporting material related to the main report.

Your scores will be recorded in Canvas for your reference along with an estimate of your running course total on a 0-100 scale. Tentatively, letter grades will span the following ranges: A (90, 100]; B (75, 90]; C (60, 75]; D (50, 60]; F [0, 50]. Please note these are *approximate* ranges and subject to change without notice (though I will notify the class of any major changes and will report final thresholds at the end of the term). Please note that failure to adhere to course policies may result in a lower letter grade than would otherwise be assigned.

Tentative schedule

Subject to change at instructor discretion.

Week	Topics	Assignments (due)
1 (8/24)	Course introduction; regression & linear algebra review; random variables and vectors	
2 (8/31)	The (simple) linear model in matrix form; least squares estimation	HW1 (Th)
3 (9/7)	Inference in regression	HW2 (Th)
4 (9/14)	Problems with the response; diagnostics and transformations	HW3 (Th)
5 (9/21)	Problems with the predictors; leverage and outliers	Midterm 1 (Th)
6 (9/28)	The (general) linear model in matrix form; geometry of least squares; F tests	HW4 (Th)
7 (10/5)	Bootstrap inference	HW5 (Th)
8 (10/12)	Model specification; polynomial and nonlinear models; multicollinearity	HW6 (Th)
9 (10/19)	Categorical predictors and interactions	HW7 (Th)
10 (10/26)	Variable selection in regression; exploratory models	HW8 (Th)
11 (11/2)	ANOVA models	Midterm 2 (Tue)
12 (11/9)	Inference in ANOVA; estimation and inference for contrasts	HW9 (Th)
13 (11/16)	Correlated errors in regression	HW10 (Th)
	Thanksgiving break	
14 (11/30)	Logistic regression	
15 (12/7)	Project workshop	Midterm 3 (Th)
Finals (12/14)		Final project due 12/17 3:30pm

Tips for success

I want you to succeed in this course. Below are some simple but effective habits:

- find a buddy or form a study group
- use office hours to discuss general questions about material and concepts, not just homework help (but that too)
- prepare summary notes and try a few extra problems before exams
- take notes in class, but listen too, and ask questions to check your understanding as we go

If you find yourself falling behind at any point during the term, or feel you are struggling with the course, please come and talk with me. The sooner you reach out, the more options I'll have to help you.

Policies

Time commitment

STAT 3530 is a four-unit course, which corresponds to a *minimum* time commitment of 12 hours per week, including class meetings, assignments, and study time. I try not to assign work in substantial excess of this minimum, but you should expect to invest about 12 to 15 hours per week on average, with occasional overage due to assignments, exams, or material requiring particularly careful study. While I aim to distribute workload as evenly as possible throughout the term and offset expected overages by adjusting assignment schedules, you should allow an extra hour or two in your schedule to accommodate variability if possible. Since class meetings account for about 3 hours and 40 minutes per week, I recommend that you budget approximately 8 to 11 hours per week outside of class meetings to study and complete assignments; this recommendation includes a buffer for week-to-week variation. Please let me know if you are regularly exceeding these amounts or if you need help managing your time efficiently in the course.

Attendance and absences

Regular attendance is essential for success in the course and required per University policy. Absences should be excusable, but you do not need to notify me unless you anticipate an extended absence or will miss an in-class assessment; I trust you to adhere to Cal Poly norms and policies regarding class attendance. Please note, however, that frequent unexplained absences may negatively impact your course grade.

Classroom environment

I support Cal Poly's commitment to building an inclusive learning environment where all students can succeed. To that end, I strive to create a classroom in which every student is treated with respect and dignity, regardless of background, beliefs, opinions, identity, or the many visible and nonvisible differences within our community. I want you to feel comfortable in class, especially when sharing your perspective, asking questions, and interacting with me and with your peers. All members of this class are therefore expected to contribute to a respectful, supportive, and inclusive climate. I expect you to treat others with respect, even (and especially) when you disagree with or do not understand their perspective. I hold myself to this standard, and I expect the same of every other student in the class. If you experience any form of disrespect or discrimination, small or large, please speak with me.

Collaboration

Collaboration with classmates is encouraged. If you work with a group on homework problems, you are expected to be an active contributor and prepare your own solutions in your own words and writing, and by submitting your work you are attesting that you have met this expectation. You should not distribute or accept copies of written solutions under any circumstances.

Use of AI

I encourage the use of AI to support, but not replace, critical thinking. If I do not want you to use AI for a particular task or assignment, I will say so explicitly. Otherwise, you may use AI at your discretion for supportive tasks, such as clarifying concepts, drafting code, and generating practice problems. For example:

- Concept review: "Remind me how leverage is defined and what it means intuitively."
- Problem-solving strategies: "Give me a few ways to check whether a regression model's error variance is constant, with examples."
- Coding help: "Provide simple R code to fit a multiple linear regression model and plot residuals."
- Extra practice: "Create a few practice problems like this one, but vary the numbers and context."

As a rule of thumb, AI use for secondary tasks is usually acceptable, but AI use for the direct resolution of primary tasks (e.g., producing full solutions to assigned problems or writing work you submit as your own) is not acceptable and may constitute academic dishonesty. To avoid crossing this line, don't paste full prompts into AI tools; many models will simply solve them (possibly incorrectly) whether you ask for a solution or not, and this is hard to unsee. If you're stuck, make up a structurally similar problem or ask for general solution strategies (like the second example prompt above). Remember that you'll need to demonstrate understanding without AI on exams, so it will benefit you to struggle with problems a little on your own. For further guidance on responsible use, see the CSU AI Commons page on [ethical AI use for students].

Remember that by submitting work, you are taking responsibility for that content in its entirety — this is true regardless of whether you use AI, but if you do, you must review and validate any and all AI-generated outputs that materially supported your work, including codes, plots, quantitative results, other analysis outputs, and written summaries or intepretations you may have consulted. I would strongly recommend adopting a practice of always doing final write-ups on your own. Writing provides a unique opportunity to synthesize and interpret findings, and doing this well requires conceptual thinking, depth of understanding, and exercise of professional (and human) discretion. Take advantage of that opportunity.

Communication and email

I encourage you to ask questions in class and during office hours, since that is the only certain means of obtaining a response within a guaranteed time frame.

I respond to most email within 24 weekday hours, but I cannot guarantee this response time and I occasionally miss messages altogether (though I try not to). I rarely answer emails at night or on weekends, so while you are welcome to write me outside of business hours, please don't expect a reply until the following business day. I also sometimes get behind on answering emails, so please wait at least a few days if it's not pressing before sending a follow-up or reminder.

Please do not ask technical questions about assignments by email.

Late and missing work

I understand that unexpected circumstances may arise and require you to temporarily rearrange your priorities and commitments on occasion during the term. You may, at any time during the term and without notice or penalty, use the following personal exceptions:

- turn in one homework assignment up to one week late
- miss one homework assignment altogether

Once your personal exceptions are exhausted, homework assignments turned in up to one week late will be awarded 50% credit unless an extension is granted in advance, and missing homework assignments will be treated as zeros. If you miss no homework assignments, your lowest score will be dropped.

No other late work will be accepted unless an exception to this policy is granted. I will consider exceptions for personal and medical emergencies or other similarly unforeseeable circumstances.

Requests for reassessment of graded work

I make my best effort to assess your work accurately and apply assessment criteria consistently across the class. While I sometimes do so imperfectly, I am also aware that granting adjustments to scores or grades can disadvantage more reticent students and favor those more comfortable approaching me about credit awarded on course assessments. So, in consideration of maintaining fairness, I ask that you limit requests for reassessment to clear mistakes, discrepancies, or oversights. And in the interest of maintaining accuracy, I also ask that you *please do* let me know if you think such an error may have occurred; if so, I will then ascertain whether other students in the class are owed credit and adjust evenly across the whole class to the best of my ability.

Please raise any possible issues with assessment in a timely manner (*i.e.,* within one week of receiving graded work) and not at the end of the term. While I may consider late requests to review previously graded work at my discretion, I make no guarantee that I will do so.

Changes to scores or final grades

Per University policy, faculty have final responsibility for grading criteria and grading judgment and have the right to alter student assessment or other parts of the syllabus during the term. It is not appropriate to attempt to negotiate scores or final grades for any reason. Once the term has concluded, final grades will only be changed in the case of clerical errors, without exception. If you feel your grade is unfairly assigned at the end of the course, you have the right to appeal your grade according to the Cal Poly academic petition procedure.

Accommodations

It is University policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities that may affect their ability to participate in course activities or to meet course requirements. Accommodation requests should be made through the Disability Resource Center (DRC).

Conduct and Academic Integrity

You are expected to be aware of and adhere to University policy regarding academic integrity and conduct. Detailed information on these policies, and potential repercussions of policy violations, can be found via the Office of Student Rights & Responsibilities (OSRR).