

STAT 676: LINEAR MODELS AND ADVANCED REGRESSION MODELING

Fall 2026

Instructor:	Ray Bai	Time:	Thu. 7:20 PM – 10:00 PM
Email:	rbai2@gmu.edu	Place:	ENGR 1107

Course Page:

<https://canvas.gmu.edu/> (Check regularly for announcements and homework assignments)

Instructor Office Hours: Thursdays 4:00-5:00 pm in Nguyen Engineering 1708 or by appointment

Course Description: This course gives a comprehensive treatment of linear models and other advanced regression techniques. In particular, we will discuss linear regression, generalized linear models, mixed effects models, nonparametric/semiparametric regression, ensemble methods, deep learning, and causal inference. This class is intended to prepare Statistics PhD students for the Applied Statistics portion of the PhD Qualifying Exam. However, Masters students and advanced undergraduates who meet the prerequisites may also take the course.

Course Structure: Each weekly meeting will be comprised of three sessions (50 minutes each) with a 5-minute break between each session. The course will consist of both lectures by the instructor and interactive components (group work and problem solving).

Prerequisites: STAT 554 or STAT 654 (or their equivalent) with a grade of B- or higher

Homework: I will assign five problem sets. Students are allowed to discuss the problems and work together with their classmates, but each student must write up and submit their own solution. All homework will be submitted and returned electronically through Canvas.

Exams: There will be two in-class, 90-minute midterm exams. The dates for the midterms are **October 1** and **November 5**. These exams are closed-book and closed-notes.

Final Project: There is a final project consisting of a written report and an oral presentation. The presentations will take place on **December 3**, and the written report is due by 11:59 PM on **December 15**. The project will be completed in several stages and include personal reflections, intermediate drafts and revisions, peer reviews, and point-by-point responses to instructor and peer feedback. While this will culminate in one final written report and oral presentation at the end of the semester, the intermediary deliverables are all part of the project grade.

Generative AI use policy: Students may use generative AI (e.g., ChatGPT, Claude, Gemini, etc.) to assist them with the following tasks:

- *Brainstorming:* clarifying concepts, suggesting packages and alternative implementations, outlining approaches, and generating checklists.
- *Editing and explanation:* improving clarity and grammar, commenting on code you have written, explaining and fixing error messages, and refining tables and figures.

Generative AI is **not permitted** for the following:

- *Outsourcing the assignment:* submitting AI-generated code, text, or slides.
- *Unverified outputs:* copying answers, code, or statistical results.

AI use must be declared on every assignment submission with a brief note at the end, e.g.,

“AI assistance: ChatGPT (date/model). Used to: [e.g., outline, debug error]. Prompts included: [...]. Substantive changes made: [...]”

You are responsible for all content you submit. Failure to adhere to the above policies will result in *both* a grade of 0 for the assignment in question *and* being reported to GMU’s Office of Academic Standards. It should be noted that AI is known to hallucinate, especially references. **Submitting fake references will result in an automatic F in the class**, so please be judicious about your AI use.

Grading: Your grade will be determined according to the following distribution:

- Homework: 10%
- Midterm 1: 30%
- Midterm 2: 30%
- Final Project: 30%

The grading scale is as follows: 93-100 = A, 90-92 = A-, 87-89 = B+, 83-86 = B, 80-82 = B-, 70-79 = C+, 60-69 = C, and 0-59 = F. Numerical grades are rounded to the nearest whole number.

Main References: We will use typed handouts prepared by the instructor. Parts of these lecture notes are *not* complete and will be filled in during lecture.

Computing: We will use the software R for data analysis and computing. You can download R for free from <https://www.r-project.org/>.

Tentative Course Schedule:

- **August 27:** course overview, linear regression, ordinary least squares (OLS)
- **September 3:** geometry of the OLS, inference for linear regression models
- **September 10:** model diagnostics and model selection for linear regression, generalized least squares
- **September 17:** penalized regression, bias-variance tradeoff
- **September 24:** linear mixed effects models
- **October 1:** **Midterm 1 (90 minutes)**, robust regression and quantile regression
- **October 8:** generalized linear models (GLMs)
- **October 15:** GLMs and generalized linear mixed models (GLMMs)
- **October 22:** nonparametric and semiparametric regression
- **October 29:** tree-based methods and ensemble methods
- **November 5:** **Midterm 2 (90 minutes)**, introduction to neural networks
- **November 12:** deep learning for regression and classification
- **November 19:** regression methods for causal inference
- **November 26:** **No class (Thanksgiving break)**
- **December 3:** project presentations

Accommodation: If you need special accommodations for examinations or any other aspects of the course, please contact me before or during the first week of the semester. Note that reasonable accommodations are available for students with a documented disability. If you have a disability and may need accommodations to fully participate in this class, contact the Office of Disability Services by phone (703-993-2474) or e-mail ods@gmu.edu. All accommodations must be approved through the Office of Disability Services.

Academic Integrity: Students should familiarize themselves with the GMU Honor Code pledge at this link: <https://academicstandards.gmu.edu/academic-standards-code/>. The *minimum* punishment for violations of the GMU Honor Code is a grade of zero for the work in question. In accordance with university policy, there may be other punishments, including an automatic F in the class and/or suspension or permanent dismissal from the university.