

# STAT 535: Linear Models

Winter 2026  
MWF 11:00–11:50 in WVB 1166

Learning Suite

Dr. Scott D. Grimshaw  
Office: WVB 2182  
Email: [grimshaw@byu.edu](mailto:grimshaw@byu.edu)  
Office Hours: MWF 2–3  
or a better time for you or your group

## Course Catalog Description:

Theory of the Gaussian Linear Model with applications to illustrate and complement the theory; random vectors, multivariate normal, central and non-central chi-squared, t, F distributions; distribution of quadratic forms; Gauss-Markov Theorem; distribution theory of estimates and standard tests in multiple regression and ANOVA models; regression diagnostics; parameterizations and estimability; model selection and its consequences.

## Prerequisites:

All Statistics Courses Expected for Graduate School:

STAT 230 & 240 & 250 & 330 & 340

All Mathematics Courses Expected for Graduate School:

MATH 112 & 113 & 213 & 314 (3 semesters calculus and linear algebra)

## Learning Outcomes:

1. Demonstrate the application of Gaussian Linear Models for observational studies and designed experiments.
2. Solve problems using random vectors.
3. Understand derivation and distribution of linear and quadratic forms.
4. Understand definitions and properties of multivariate normal, non-central chi-square, t, and F distributions.
5. Derive maximum likelihood estimates of parameters in a linear model with normal, independent errors.
6. Derive the properties of linear models estimates (Gauss-Markov Theorem, Wald tests).
7. Derive tests on linear hypotheses by estimation of both the unconstrained and constrained model (full and reduced LRT/ANOVA).
8. Apply the cell means model in one-way and multiway fixed designs, interpret parameters from alternative model reparameterizations, estimability.
9. Explore consequences of model assumption violations and use regression diagnostics to identify possible model violations.
10. Derive theoretical consequences of overfitting and underfitting in model selection.

## Course Grade:

20% In-Class Work and Homework  
50% Projects  
30% Final Exam

A = 93-100    A- = 90-92.9  
B+ = 87-89.9    B = 83-86.9    B- = 80-82.9  
C+ = 50-79.9    E = 0-49.9

Grades may be lowered by the instructor if you fail to meet University standards.

## Textbooks:

Hocking (2005) *Methods and Applications of Linear Models* 2nd ed  
(BYU Students Can Download from HBLL)

Rencher & Schaalje (2008) *Linear Models in Statistics* 2nd ed **Chapters 3,4**  
(BYU Students Can Download from HBLL)

*Note:* The other two books frequently used in the linear models theory course at top PhD programs are Navishanker and Dey (2001), *A First Course in Linear Model Theory*, and Christensen (2011), *Plane Answers to Complex Questions: The Theory of Linear Models*.

*Note:* There are many good ‘regression model’ books that emphasize the interpretation and application (while still having some theory). Your Stat 536 book, ISLR, is one. Others are Weisberg *Applied Linear Regression* (4ed), Fox and Weisberg *An R Companion to Applied Regression* (3ed), and Sheather *A Modern Approach to Regression with R*.

## In-Class and Homework & Projects:

Produce **your own** assignment to turn in for grading. The work you submit should genuinely reflect your understanding. To receive full credit, answer all assigned questions completely, accurately, and showing all work.

Late assignments will not be accepted.

## Final Exam:

The goal of the final exam is to assess your skill of the course learning outcomes and other topics covered in the class. Some of the content is similar to the Open Book / Data Analysis portion of the Comprehensive Exam.

## AI Use Policy

AI tools can be powerful resources for debugging code, clarifying statistical concepts, and technical writing. In this course, AI is permitted as a learning aid, not as a replacement for your own reasoning, coding, analysis, or writing.

Your goal is to learn to think like a statistician / data scientist, and not to have AI do that thinking for you.

## **Student Disability**

Brigham Young University is committed to providing a working and learning atmosphere that reasonably accommodates qualified persons with disabilities. A disability is a physical or mental impairment that substantially limits one or more major life activities. Whether an impairment is substantially limiting depends on its nature and severity, its duration or expected duration, and its permanent or expected permanent or long-term impact. Examples include vision or hearing impairments, physical disabilities, chronic illnesses, emotional disorders (e.g., depression, anxiety), learning disorders, and attention disorders (e.g., ADHD). If you have a disability which impairs your ability to complete this course successfully, please contact the University Accessibility Center (UAC), 2170 WSC or 801-422-2767 to request a reasonable accommodation. The UAC can also assess students for learning, attention, and emotional concerns. If you feel you have been unlawfully discriminated against on the basis of disability, please contact the Equal Employment Office at 801-422-5895, [eo\\_manager@byu.edu](mailto:eo_manager@byu.edu), or visit <https://hrs.byu.edu/equal-opportunity> for help.

## **Mental Health**

Mental health concerns and stressful life events can affect students' academic performance and quality of life. BYU Counseling and Psychological Services (CAPS, 1500 WSC, 801-422-3035, [caps.byu.edu](http://caps.byu.edu)) provides individual, couples, and group counseling, as well as stress management services. These services are confidential and are provided by the university at no cost for full-time students. For general information please visit <https://caps.byu.edu>; for more immediate concerns please visit <http://help.byu.edu>.

## **Honor Code**

In keeping with the principles of the BYU Honor Code, students are expected to be honest in all of their academic work. Academic honesty means, most fundamentally, that any work you present as your own must in fact be your own work and not that of another. Violations of this principle may result in a failing grade in the course and additional disciplinary action by the university. Students are also expected to adhere to the Dress and Grooming Standards. Adherence demonstrates respect for yourself and others and ensures an effective learning and working environment. It is the university's expectation, and every instructor's expectation in class, that each student will abide by all Honor Code standards. Please call the Honor Code Office at 422-2847 if you have questions about those standards.

## **Preventing & Responding to Sexual Misconduct**

The health and well-being of students is of paramount importance at Brigham Young University. If you or someone you know has experienced sexual harassment (including sexual violence), there are many resources available for assistance.

In accordance with Title IX of the Education Amendments of 1972, BYU prohibits unlawful sex discrimination, including sexual harassment, against any participant in its education programs or activities. The university also prohibits sexual harassment by its personnel and students. Sexual harassment occurs when

- a person is subjected to unwelcome sexual speech or conduct so severe, pervasive, and offensive that it effectively denies their ability to access any BYU education program or activity;

- any aid, benefit, or service of BYU is conditioned on a person's participation in unwelcome sexual conduct; or
- a person suffers sexual assault, dating violence, domestic violence, or stalking on the basis of sex.

University policy requires all faculty members to promptly report incidents of sexual harassment that come to their attention in any way, including through face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Incidents of sexual harassment should be reported to the Title IX Coordinator at [t9coordinator@byu.edu](mailto:t9coordinator@byu.edu) or (801) 422-8692 or 1085 WSC. Reports may also be submitted online at <https://titleix.byu.edu/report> or 1-888-238-1062 (24-hours a day).

BYU offers confidential resources for those affected by sexual harassment, including the university's Sexual Assault Survivor Advocate, as well as a number of non-confidential resources and services that may be helpful. Additional information about Title IX, the university's Sexual Harassment Policy, reporting requirements, and resources can be found at <http://titleix.byu.edu> or by contacting the university's Title IX Coordinator.