

Course: IENG 314 – Advanced Analysis of Engineering Data

Semester: Fall 2018

Number of credit hours: 3

Description: Introduction to linear statistical models. Design and analysis of simple experimental configurations occurring frequently in engineering studies. Similarities and differences between regression and experimental design models emphasized in a vector-matrix setting.

Prerequisite: IENG 213, Co-Requisite: Math 251

Textbook: Applied Linear Regression Models, by Kutner, Nachtsheim, and Neter; Fourth Edition, McGraw-Hill/Irwin Publishers, 2004.

Instructor: Kenneth Currie, Ph.D., P.E.
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Office Hours: MW 1-3, or by appointment; The QR Code below is a link to my availability; email a request to meet based on my availability.



Course Goals:

1. To provide students with the basic concepts of linear regression and analysis of variance, and techniques to apply them to appropriate data sets.
2. To provide students with knowledge on the use of software to solve statistical analysis problems.
3. To provide students with hands-on experience in the application linear regression and analysis of variance.

Student Learning Objectives:

Upon completing the course, students will be able to:

- a. Recognize problems that can be solved using linear regression and analysis of variance tools.
- b. Perform univariate data analysis on data sets; use statistical software to create scatter plots and histograms.
- c. Perform simple and multiple regression analysis, both manually and using statistical packages.
- d. Perform statistical inferences related to regression analysis.
- e. Perform appropriate tests to check the aptness and the assumptions of the regression model, diagnose problems, and take remedial actions (e.g. variable transformation, and weighted least squares).
- f. Perform simultaneous inferences.

- g. Use the matrix algebra in regression.
- h. Understand “multicollinearity” and its effects in multiple regression. Also learn how to diagnose it and the possible remedial actions.
- i. Perform polynomial regression.
- j. Know how to handle qualitative predictor variables.
- k. Work with stepwise regression.
- l. Evaluate regression models using different criteria.
- m. Identify outliers, and influential cases.
- n. Build complete regression models from a to z.
- o. Perform one-factorial analysis of variance (both fixed and random effect models)
- p. Understand the assumptions of ANOVA, how to test for them, and the remedial measures.
- q. Perform multiple range tests.
- r. Compare treatments with a control.
- s. Perform two-factorial ANOVA.
- t. Apply statistical packages to both regression analysis and analysis of variance.

Course Topics:

- Review of Basic Statistics Relevant to Regression and Analysis of Variance (1 week)
- Linear Regression with one Independent Variable (1 week)
- Inferences in Regression Analysis (2 weeks)
- Diagnostics and Remedial Measures (1 week)
- Simultaneous Inferences (1 week)
- Matrix Approach to Simple Regression Analysis (1 week)
- Multiple Regression (2 weeks)
- Polynomial Regression (1 week)
- Building the Regression Model (1 week)
- Diagnostics and Remedial Measures (1 week)
- Qualitative Predictor Variables (1 week)
- Analysis of Variance (2 weeks)

Course Contribution to Professional Component:

Engineering topics 100%. This course has significant design content.

Course Relationship to Program Educational Outcomes:

The course relates strongly to the following program educational outcomes.

1. The course enables the students to acquire the ability to use modern and classical industrial engineering methodologies pertaining to advanced engineering analysis of data (Outcome 1). The key abilities the students will acquire are as below.
 - a) Confidence intervals and hypothesis testing
 - b) Regression analysis
 - c) Analysis of variance
 - d) Learn and use statistical software packages
2. The course enables the students to acquire the ability to apply knowledge of matrix algebra (Outcome 2). The key abilities the students will acquire are as below.
 - a) Ability to apply matrix algebra for regression analysis
3. The course enables the students to acquire the ability to analyze and interpret data and develop implementation strategies so that results will be achieved and findings will be communicated effectively. (Outcome 3) The key abilities the students will acquire are as below.
 - a) Analyze and interpret data

Performance Indicators:

The student performance indicators that are associated with the key abilities are:

1. Recognize problems that can be solved using linear regression and analysis of variance.
2. Perform simple and multiple regression analysis, both manually and using statistical packages.
3. Perform statistical inferences related to regression analysis.
4. Perform appropriate tests to check the aptness and the assumptions of the regression model, diagnose problems, and take remedial actions (e.g. variable transformation, and weighted least squares).
5. Know how to handle qualitative predictor variables. Work with stepwise regression. l) Evaluate regression models using different criteria. m) Identify outliers, and influential cases
6. Perform one-factorial analysis of variance (both fixed and random effect models) p) Understand the assumptions of ANOVA, how to test for them, and the remedial measures.

Grading:	Range	Grade
	97 – 100	A+
	93 – 96	A
	90 – 92	A-
	87 – 89	B+
	83 – 86	B
	80 – 82	B-
	77 – 79	C+
	73 – 76	C
	70 – 72	C-
	67 – 69	D+
	63 – 66	D
	60 – 62	D-
	0 – 59	F

Exam #1 – Tuesday, September 18th, 2018 – 20%

Exam #2 – Thursday, October 18th, 2018 – 20%

Design Project Milestones – Thursday, September 27th, 2018 – 5%

– Thursday, November 29th, 2018 – 15%

(There is a one-week grace period for each of the project milestones and it coincides with the start of class on the due date. Once the grace period has expired, late submissions will face 10% reductions for every 24-hour period that it is late.)

Final Exam – Wednesday, December 12th, 2018 from 8:00 am – 10:00 am – 25%

Homework (Due promptly at 3:30 pm on the assigned date – late submissions not accepted) and In-Class Problems – 10%

Attendance, Out-of-class participation, and Instructor's discretion – 5%

Statement on Attendance:

There is a significant amount of material to cover in this class and it has been shown that there is a strong correlation to student absences and poor performance in the class. Therefore, student attendance is mandatory unless excused by the instructor. Attendance is taken promptly at 3:30 pm and if you are not in your seat at 3:30 pm you are marked absent regardless of when you arrive to class. The basis for an excused absence will follow University and IMSE policy. Students who are absent from class for any reason are responsible for all missed work and there will be no makeup for In-class assignments turned in on the day of class. After three unexcused absences, students will

begin to lose a percentage point for each additional missed class. There are several out-of-class participation events that will be used for complementing the attendance grade that include Fall Fling, Trunk-or-Treat, Gochenour Lecture, Alumni Academy Banquet, Advisory Committee Panel Discussions, etc.

Exams:

All examinations will be **closed book** and **closed notes with the exception of a hand-printed 8.5” x 11” study sheet marked on only one side of the sheet**. All work must be shown in order to receive full credit, and instructions should be followed in order to avoid point deductions. There will be **no makeup exams**. However, if you miss one of the first two exams due to serious illness (documented) or serious family emergency (documented), then you will take a **cumulative final exam**. More specifically, if a student misses an exam, the student must email me explaining why they will miss (or have missed) the exam within 24 hours before (or after the exam). There is no makeup (cumulative final) exam without a proper and certified excuse. The regular final exam will be a 75-minute exam covering the most recent topics. In contrast, the **cumulative final exam** will be a 2-hour exam covering all topics. If you miss both of the first two exams, you will receive a zero on one of the exams and will need to take the cumulative final exam to make up for the other one. If you miss only the final exam, you will be required to take the cumulative final exam.

Communication:

The WVU MIX email system will be used for all communication. The students are responsible for checking their MIX email regularly for information regarding assignments, lecture information, and any other important course related information. Students may be asked to print out information from the attachment in their email and bring it to class. Not all material will be sent in electronic form. Some material only in the form of hard copies will be distributed in class.

Class Schedule:

Week	Topic	Reading
August 16	Review of basic statistics/ Linear regression w/ one var.	Videos of IE 213
August 23	Linear regression/ Inferences in regression analysis	Ch.1
August 30	Inferences in regression analysis	Ch.2
September 6	Diagnostics and remedial measures	Ch.3
September 13	Simultaneous inferences	Ch.4
September 17	Optional Review 6:00 – 7:30 pm; Place TBD	
September 18	Exam #1; IENG 213 Review & Chapters 1 – 3	
September 20	Matrix Approach to Simple Regression Analysis	Ch.5
September 27	Matrix / Multiple Regression (Phase 1 of Project due)	Ch.6
October 1	Makeup Class – 6:00 – 7:30 pm; Place TBD	
October 4	Class Cancelled – Gochenour Lecture; SAS-E 1021	
October 11	Multiple Regression	Ch.7
October 17	Optional Review 6:00 – 7:30 pm; Place TBD	
October 18	Exam #2; Chapters 4 – 7	
November 1	Polynomial Regression	Ch. 8
November 5	Makeup Class – 6:00 – 7:30 pm; Place TBD	
November 6	Class Cancelled – Election Day	
November 8	Categorical Predictor Variables	Ch.8

November 15	Building the regression model-Model selection	Ch.9
Nov. 19 – 23	Thanksgiving Break	
November 27	Analysis of Variance	TBA
December 4	Analysis of Variance	TBA
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Final Exam:	Wednesday, December 12 th , 2018; 8 am to 10 am.	

Academic Integrity Statement

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, instructors will enforce rigorous standards of academic integrity in all aspects and assignments of their courses. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the West Virginia University [Academic Standards Policy](http://catalog.wvu.edu/undergraduate/coursecreditstermsclassification)(<http://catalog.wvu.edu/undergraduate/coursecreditstermsclassification>). Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see your instructor before the assignment is due to discuss the matter.

Academic Standards Policy, including Academic Dishonesty

The WVU Catalog contains the full [Academic Standards Policy](#).

- [Resources for Faculty and Students for Reporting and Appealing Violations of Academic Standards](#)

Adverse Weather Statement

In the event of inclement or threatening weather, everyone should use his or her best judgment regarding travel to and from campus. Safety should be the main concern. If you cannot get to class because of adverse weather conditions, you should contact your instructor as soon as possible. Similarly, if your instructor(s) are unable to reach the class location, they will notify you of any cancellation or change as soon as possible, using agreed upon methods to prevent students from embarking on any unnecessary travel. If you cannot get to class because of weather conditions, instructors will make allowances relative to required attendance policies, as well as any scheduled tests, quizzes, or other assessments. [adopted 9-8-2014]

Attendance Policy

The WVU Catalog contains the full [Attendance Policy](#).

Campus Safety Statement

The WVU Police are committed to creating and maintaining a safe learning environment for all students, faculty, and staff. Part of this mission includes educating the campus community on how to respond to potential campus threats, such as the threat of an active shooter on campus or other suspicious behaviors. Fortunately, WVU Police offer training - both online and in-person - on how to handle a variety of campus safety scenarios. All students are encouraged to visit the [WVU Police](https://police.wvu.edu/) webpage, in particular the content under the [Active Shooter](https://police.wvu.edu/training) training program. Students are also encouraged to report any suspicious behaviors on campus using the [Report a Threat](https://police.wvu.edu/emergency-management/threat-assessment) portion of the webpage. Additional materials on campus safety prepared by WVU Police, including special safety tips and training, will also be provided on our eCampus page. [adopted 10-2-17]

Inclusivity Statement

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in your classes, please advise your instructors and make appropriate arrangements with the [Office of Accessibility Services](https://accessibilityservices.wvu.edu/). (https://accessibilityservices.wvu.edu/)

More information is available at the [Division of Diversity, Equity, and Inclusion](https://diversity.wvu.edu/) (https://diversity.wvu.edu/) as well. [adopted 2-11-2013]

Incomplete Policy

The WVU Catalog contains the full [Incomplete Policy](#).

Sale of Course Material Statement

All course materials, including lectures, class notes, quizzes, exams, handouts, presentations, and other course materials provided to students for their courses are protected intellectual property. As such, the unauthorized purchase or sale of these materials may result in disciplinary sanctions under the [Student Conduct Code](https://studentconduct.wvu.edu/policies-and-procedures). (https://studentconduct.wvu.edu/policies-and-procedures) [adopted 5-11-2015]

Sexual Misconduct Statement

West Virginia University does not tolerate sexual misconduct, including harassment, stalking, sexual assault, sexual exploitation, or relationship violence [[BOG Rule 1.6](#)]. It is important for you to know that there are resources available if you or someone you know needs assistance. You may speak to

a member of university administration, faculty, or staff; keep in mind that they have an obligation to report the incident to the [Title IX Coordinator](https://titleix.wvu.edu/staff). (<https://titleix.wvu.edu/staff>)

If you want to speak to someone who is permitted to keep your disclosure confidential, please seek assistance from the [Carruth Center](#), **304-293-9355** or **304-293-4431** (24-hour hotline), and locally within the community at the [Rape and Domestic Violence Information Center](#) (RDVIC), **304- 292-5100** or **304-292-4431** (24-hour hotline).

For students at WVU-Beckley, contact the [Women's Resource Center](#) at 304-255-1585 (toll free at 1-888-825-7836) or [REACH](#) at 304-340-3676. For students at WVU-Keyser, contact the WVU-Keyser [Psychological Services Office](#) at 304-788-6976, and locally in Keyser, the [Family Crisis Center](#), 304-788-6061 or 1-800-698-1240 (24-hour hotline).

For more information, please consult [WVU's Title IX Office](https://titleix.wvu.edu/confidential-resources) (<https://titleix.wvu.edu/confidential-resources>).

Student Evaluation of Instruction Statement

Effective teaching is a primary mission of West Virginia University. Student evaluation of instruction provides the university and the instructor with feedback about your experiences in the course for review and course improvement. Your participation in the evaluation of course instruction is both strongly encouraged and highly valued. Results are strictly confidential, anonymous, and not available to the instructor until after final grades are released by Admissions and Records. Information about how you can complete this evaluation will be provided by your instructor. [adopted 4-14-2008]

Prepared By: Ken Currie, IMSE, CEMR

Date: 08/16/2018