

Course: IENG 314 - Advanced Analysis of Engineering Data

Semester: Spring 2015

MWF 1:00-1:50 p.m.

MRB-209

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-req.:** Math 251

Textbook: Applied Linear Regression Models, by Kutner, Nachtsheim, and Neter, Fourth Edition- R.D. Irwin Publishers

Additional References:

SAS User=s Guides (Basic and Statistics), SAS Institute, Inc.

Instructor: Wafik Iskander, Ph.D., P.E.
Professor, IMSE Department
Email: Wafik.Iskander@mail.wvu.edu
Phone: (304) 293-9436

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 - 33%, Basic Math Contents - 67%

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 regression analysis, analysis of variance, confidence intervals and hypothesis testing, and statistical packages (Outcome 1).
2. The course enables the students to acquire the ability to apply knowledge of matrix algebra (Outcome 2).

Grading Elements, Weighting and Scale (Tentative):

| Grade Element | Weight | Grade Scale |
|--------------------|--------|-------------|
| Two Midterm Tests | 50% | A =>88 |
| Final Test | 25% | B =>77 |
| Project | 10% | C=>66 |
| Homework & Quizzes | 15% | D=>55 |
| | | F<55 |

Statement on Attendance:

Student attendance is mandatory unless excused by the instructor. The basis for an excused absence will follow University and IMSE policies. Roll will not be taken, however the students are responsible for all the material covered in class and all the announcements made (e.g. date of mid-term tests and deadlines of homework and project). If you know you will be absent for a homework or test, make arrangements with the instructor beforehand.

Statement on Social Justice:

West Virginia University is committed to social justice. I concur with that commitment. I expect to foster a nurturing learning environment that is based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, you must make appropriate arrangements through Disability Services (293-6700). They will identify the nature of the accommodation your disability requires.

General Policies:

1. A comprehensive understanding of your class notes and the sections covered from the textbook constitutes a minimal study material.
2. Responsibilities of the professor:
 - To provide a comprehensive treatment of regression analysis and analysis of variance in a clear, concise and interesting manner.
 - To provide assistance when needed.
 - To evaluate student performance and subject mastery in an objective and fair manner.
3. According to the department policy, no make-up tests are allowed. A student who misses a test without prior permission of the instructor must be assigned a 0 (zero). The secretary of the IMSE Department will have a telephone number where the instructor can be reached.
4. All homework will be collected and graded. They have to be turned in a neat, clean, and readable format. Late homework will not be accepted.
5. No credit will be given for attendance. Class participation is highly encouraged and will affect the final grade in borderline cases.
6. Incomplete grades are not allowed.
7. No group work is allowed in homework. No copying is allowed between groups in group projects. It is very important to work individually or within the group. If you have any problem or need help, consult the instructor.
8. Learning SAS is primarily the responsibility of each student. However, special help sessions may be arranged for those who need help to get started.
9. Projects: Teams of three students will work together on the case and submit one report for each team. Project reports have to be written in a professional way, and in a proper report format with a cover letter, a summary, and a detailed body.
10. In all tests, quizzes and homework, the major part of the grade will be assigned to the logic followed and the intermediate steps taken. The final answer will not carry any weight unless it is properly justified. Correct mathematical notation and proper English language are to be followed.

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Analysis of Engineering Data

| WK | TOPIC | READING | ASSIGNMENTS |
|-----|--|-----------|----------------------------|
| 1. | Review of Basic Statistics | ----- | TBA |
| 2. | Linear Regression with one Predictor | Ch. 1 | 7, 8, 20, 24, 28 |
| 3. | Inferences in Regression and Correlation Analysis | Ch. 2 | 5, 8, 14 |
| 4. | Inferences in Regression and Correlation Analysis | Ch. 2 | 24, 30, 31, 32 |
| 5. | Diagnostics and Remedial Measures | Ch. 3 | 4(a,d,g), 8(e), 13(a,b) |
| 6. | Simultaneous Inferences and Other Topics and TEST 1 | Ch. 4 | 3, 7, 16, 17 |
| 7. | Matrix Approach to Simple Regression Analysis | Ch. 5 | 5, 13, 17, 24 |
| 8. | Multiple Regression | Ch. 6 | 5(b,e,f), 7, 8 |
| 9. | Multiple Regression | Ch. 7 | 3, 12, 16, 24 |
| 10. | Regr. Models for Quantitative and Qualitative Pred. | Ch. 8 | 6 |
| 11. | TEST 2 Regr. Models for Quantitative and Qualitative Pred. | Ch. 8 | 11, 24(b) |
| 12. | Spring Break | | |
| 13. | Building the Regression Model - Model Selection | Ch. 9 | 4, 13(c), 14 |
| 14. | Diagnostics and Remedial Measures | Ch. 10,11 | 10.5 |
| 15. | Analysis of Variance | TBA | TBA |
| 16. | Analysis of Variance | TBA | TBA |

Final Test: Tuesday, May 5, 2015; 11 a.m. to 1 p.m.