**STAT 415/615** **Regression** **Fall 2026**

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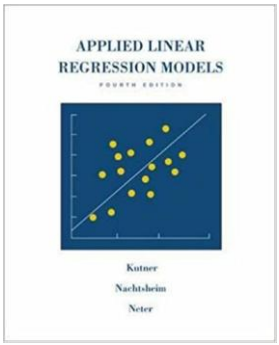
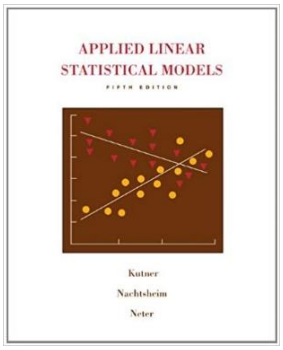
| **Time** | Monday & Thursday, 5:30 – 6:45 pm |
| **Room** | TBD |
| **Instructor** | Michael Baron |
| Office | DMTI 106-D |
| Office hours | Monday & Thursday 4:00 – 5:00 pm |
| Email | baron@american.edu |
| Website | https://dr-baron.github.io/ |
| **Website** | https://dr-baron.github.io/615/ |




**Textbook:**

- *Applied Linear Regression Models*, 4th edition, by M. Kutner, C. Nachtsheim, and J. Neter. McGraw-Hill, 2004 (701 pp). ISBN 0073014664

  OR

- *Applied Linear Statistical Models*, 5th edition, by M. Kutner, C. Nachtsheim, J. Neter, and W. Li. McGraw-Hill, 2004 (1396 pp). ISBN 007310874X

  - But not both. Chapters 1-14 are identical in these books.

Text only, without a CD, is fine. All textbook data sets are available in R library `alr4`.

**Course description:**

Regression uses data to study mathematical relations among two or more variables, with the purpose of understanding trends, identifying significant predictors, and forecasting. The course covers simple and multiple regression, the method of least squares, analysis of variance, model building, regression diagnostics, and prediction. Students estimate and test significance of regression slopes, evaluate the goodness of fit, build optimal models, verify regression assumptions, suggest remedies, and apply regression methods to real datasets using statistical software. AU Core: Capstone. Prerequisite: STAT-302, STAT-320, or STAT 614.

**Course plan:**

1. Introduction, motivation, and examples [1.1-1.2]
2. Review of basic statistical inference. Normal, t, and F distributions. Hypothesis testing. P-values. [Handouts]
3. Introduction to R [Practice and handouts]
4. Linear regression: model, estimation, inference, prediction. Regression and correlation. $R^2$ [Chap. 1-2]
5. Regression diagnostics I: non-normality, nonlinearity, heteroscedasticity [Chap. 3]
6. Simultaneous estimation. Other regression models [Chap. 4]
7. Multiple regression. Matrix approach. Analysis of variance. Analysis of residuals. Partial correlation and multiple correlation coefficient [Chap. 5-6]
8. Model building. Model selection and validation. Extra sum of squares [Chap. 7-8]
9. Regression diagnostics-II. Influential observations and outliers. Effect of multicollinearity. Robust regression. Ridge regression [Chap. 9-10]
10. Regression diagnostics-III. Symptoms and remedies. Transformation of variables [Chap. 10]
11. Dummy variables, interactions, and related methods [Chap. 11]
12. (If time permits) Nonlinear relations. Logistic regression. [Chap. 13-14]

**Learning Objectives**

The learning objective of this course is to give you the main concepts and a working knowledge of regression techniques that are routinely used to analyze different types of data. At the end of this course, you are expected to be able to:

- Identify studies and data sets where regression can be used to address questions of interest.
- Use software to graphically display regression data.
- Propose a regression model to address the research questions in a study.
- Understand the principle of the Least Squares Estimation.
- Use software to conduct regression analysis. This includes variable selection, parameter estimation, diagnostics, and prediction.
- Interpret and summarize the results of regression analysis results in the context of the study.
- Understand limitations of the regression analysis.
- Design and conduct a study to investigate a research problem using real-world data and regression analysis. (Stat 615)
- Derive the least squares estimators for linear regression. (Stat 615)
- Write the linear regression model in matrix form. (Stat 615)
- Understand matrix derivations for estimation, testing, and model building in multiple linear regression. (Stat 615)

**Assignments and Grading:**

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| Weekly homework assignments and mini-projects | 15% | Homework will be assigned weekly and submitted via **Canvas**. A steady effort to work out all the assigned problems is essential for learning statistical methods and for the successful performance in this course. Complete homework solutions will be posted after the homework deadline. A typical homework will include a few problems to do by hand, to see how things work, and a few realistic problems to do using software. Late submissions may be accepted with a 40% deduction plus 10% per day. |
| Weekly quizzes | 20% | Short quizzes at the end of Thursday classes. Each quiz covers the material of the preceding week and the latest homework. During a quiz, you may use **one cheat sheet**. |
| Midterm Test | 20% | The midterm covers several chapters of the material. Taken in class; notes and our course materials are allowed, computers are not. Time: 1 hour 15 minutes. |
| Final project | 15% | Using learnt methods, you will be asked to do the necessary regression modeling and data analysis and either write a report or make a slide presentation (your choice) summarizing results and answering specific questions of your project. Work in groups of up to four; each group submits one report or makes one presentation. |
| Final Test | 30% | The final test covers the 2nd part of the course, but it is cumulative indirectly because the 2nd part is heavily based on the 1st part. Taken in class, during our regular class time on Monday, 12/14/2026, 5:30 - 8:00. Notes and our course materials are allowed, but of course, serious preparation is essential for getting a good grade. Time: 2.5 hours. |

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| 90 – 100 % = A | 87 – 90 % = A- | 83 – 87 % = B+ | 80 – 83 % = B |
| 77 – 80 % = B- | 73 – 77 = C+ | 70 – 73 % = C | 60 – 70 % = C- |

**Software:** We'll study regression methods and implement them in **R** and **Python**, including frequent classroom demonstrations and examples. R codes will be developed and published on the course web site. Advanced programming skills and advanced computer knowledge are *not* required.

To use R, install it from https://cran.r-project.org/, free of charge.

**Tips**

- Collaboration on homework is ok. Even encouraged! Quizzes and exams are to be done individually.
- On quizzes and exams, ***show your work***. I will grade your solutions, not your answers.
- *No late assignments.* Sometimes exceptions are granted, given a serious reason. However, it is possible to take an exam or quiz early, for example, because of a business trip or a religious holiday. So, plan ahead.
- A steady effort to review material and work out all the assigned problems is your best way to succeed in this course. Always ***keep up*** with the course because material is built upon the previously covered concepts.
- Use your right to ask questions in class and during office hours.
- For each exam and quiz, review all the new concepts, methods, formulas, etc. Try to understand the methods rather than to memorize them.
- For each quiz, it may be useful to prepare a brief ***summary*** of important formulas and methods that you may need. Arrange it on a sheet of paper in the most convenient way. Do the same for the exams! Such summaries will help you use your exam time efficiently.

**Support Services**

A wide range of services is available to support you in your efforts to meet the course requirements.

***Quantitative Tutoring Lab and Online Statistical Software Support.*** Tutors should be able to help you with Calculus, Algebra, and basic Statistics, maybe statistical software, but you should not count on getting homework solutions for advanced Statistics courses! The Tutoring Lab offers both one-on-one and drop-in tutoring. Spring semester hours are: Mon 11:30 am – 3:00 pm and 5:30 – 7:00 pm; Tue 1:00 – 3:00 pm and 5:30 – 7:00 pm; Wed 11:00 am – 7:00 pm; Thu 1:00 – 3:00 pm and 5:30 – 7:00 pm, Fri 10:00 – 12:00. Online tutoring is available on https://american.mywconline.net/. Visit https://www.american.edu/provost/eagle-learning-center/quantitative.cfm or email quantsupport@american.edu for more information. This service is *free* for all our students.

***Software support*** - CTRL Connect, ctrl@american.edu, 202-885-2117, Help with Python, Help with R.

***Counseling Center*** (x3500, https://www.american.edu/ocl/counseling/) offers counseling and consultations regarding personal concerns, self-help information, and connections to off-campus mental health resources.

***Academic Support and Access Center*** (x3360) offers study skills workshops, individual instruction, tutor referrals, supplemental Instruction, writing support, and technical and practical support and assistance with accommodations for students with physical, medical, or psychological disabilities.

***Religious Holidays.*** Students may receive accommodation in the course for the observance of a religious and/or cultural holiday. The student should notify the professor as soon as possible should such a need exist. More information about accommodations for religious and/or cultural holidays can be found at www.american.edu/ocl/kay/request-for-religious-accommodation.cfm.

***Emergency Preparedness.*** In the event of an emergency, students should refer to the AU Web site (http://www.american.edu/emergency) and the AU information line at (202) 885-1100 for general university-wide information. In case of a prolonged closure of the University, I send updates to you by email and will post all announcements on the course web site.