



**Time (Location): Wednesdays 5:30-8:00 PM (DMTI 114)**

**\*\*Note: All classes will be online via Zoom for at least the first three weeks.\*\***

**Online Classroom** (link on Canvas) Meeting ID: 943 8118 0458 Passcode: MILLERREG

Full details about using Zoom can be found in *REQUIRED MATERIALS & COURSE TOOLS* → Zoom below.

**Instructor:** Jaime Miller

**Email:** [jmiller@american.edu](mailto:jmiller@american.edu)

**Office:** DMTI 208K

**Office Hours:**

**Tuesdays** 12-1 PM & 4-5 PM, **Wednesdays** 12-1 PM, **Fridays** 12-1 PM;

**OR by appointment**

All office hours will be on **Zoom** in the **Office Hours meeting room** until further notice. Once we are back on campus, I may move some of my scheduled hours to in-person hours and will always notify you of any changes.

I reserve at least one hour per week on weekdays for appointments outside of my scheduled hours. Please send me an email in advance if you would like to make an appointment.

**Office Hours meeting room** (link on Canvas) Meeting ID: 954 2463 9566 Passcode: MILLEROH

Please see full details in *REQUIRED MATERIALS & COURSE TOOLS* → Zoom.

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## COURSE DESCRIPTION

Topics covered in this course include simple and multiple regression, least squares, curve fitting, graphic techniques, and tests and confidence intervals for regression coefficients.

Prerequisite: An Intermediate Statistics Course (STAT-302, STAT-320, or STAT-514/614)

### Overview of Topics

1. Introduction, motivation, and examples [1.1-1.2]
2. Review of basic statistics and elementary statistical inference: Summarizing data; Parameters and statistics; Sampling distributions; Normal, t, and F distributions; Confidence Intervals; Hypothesis testing; P-values. [Handouts and Supplementary Materials]
3. Introduction to R [Handouts and Supplementary Materials]
4. Linear regression: model, estimation, inference, prediction. Regression and correlation.  $R^2$  [Chap. 1-2]
5. Regression diagnostics: 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. Extra sums of squares. [Chap. 7]
9. Dummy Variables. Interaction models. [Chap. 8]
10. Model building. Model selection and validation. [Chap. 9]
11. Regression diagnostics-II. Influential observations and outliers. Effect of multicollinearity. Robust regression. Ridge regression [Chap. 10-11]

Time permitting, we may also cover some of the following topics:

12. Regression diagnostics-III. Symptoms and remedies. Transformation of variables. Missing data. Analysis of covariance. Comparison of regression lines. [Chap. 10-11]
13. Nonlinear relations. Logistic regression. [Chap. 13-14]

To see my *anticipated* schedule of what we will cover each week and assigned work, please reference the “**Course Schedule**” on Canvas. The schedule may be adjusted and updated regularly, so pay close attention to my weekly announcements.

## COURSE LEARNING OUTCOMES

The 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 the 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.
- Investigate a research problem using real-world data and regression analysis.
- Write the linear regression model, the estimators, and residuals in matrix form.
- Derive the least squares estimators for linear regression. (STAT 615 only)
- Develop proofs and derivations for theory behind methods used in regression analysis (such as unbiased estimators for important parameters and statistical inference techniques). (STAT 615 only)
- Understand matrix derivations for estimation, testing, and model building in multiple linear regression. (STAT 615 only)

### Capstone Learning Outcomes (STAT 415)

**Application:** Build on prior knowledge, skills, or dispositions in a new context. *Throughout the course, you will apply regression inference and diagnostic methods to a wide variety of simulated and real-world examples. Regression techniques will be regularly illustrated using examples from diverse fields, and you will have hands-on experience of analyzing datasets including regression modeling, diagnostics, performance evaluation, and communication of applied methodologies and obtained results.*

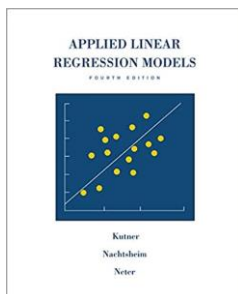
**Synthesis:** Identify and execute a significant project that addresses a substantive disciplinary or professional concern. *As part of the course, students will work on a series of mini-projects (included in the weekly assignments) to investigate research problems using real-world data and regression analysis, work in teams (if desired), report results, and discuss your conclusions. These require you to use regression methods appropriately, execute the analysis using statistical software, and communicate analytical results to non-statisticians.*

**Reflection:** Articulate the knowledge, skills, or dispositions gained during the student’s undergraduate experience or used in the project. *Students will learn to revise their approaches based on their self-assessment, including rigorous statistical tests and performance criteria, as well as the feedback obtained from the course instructors.* The assignments with mini- projects will include discussion on the advantages and limitations of utilized methods and models. Through this discussion, students reflect on the knowledge and skills acquired during their undergraduate study that apply to the problems at hand.

## REQUIRED MATERIALS & COURSE TOOLS

### Textbook

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



*This book is available through the AU bookstore and other sources. You will use it to keep up with weekly readings and some assignment problems. Text only, without a CD, is fine, as all necessary textbook data sets will be available on Canvas.*

### Software

*During the course, we will be learning regression methods and implementing them in **R**. Advanced programming skills and advanced computer knowledge are not required. To install R, please refer to the instructions posted on Canvas.*

### Canvas

[Canvas](#) is where I will post all course materials, information, announcements, etc. and collect graded work. If you need assistance with Canvas, please reference this [resource page](#).

### Zoom

We will be using Zoom for **online classes** (all class meetings for at least the first three weeks) and **office hours** (all office hours until further notice). To join a meeting, you **must** sign in to Zoom through the American University domain.

- If using the web, go to <https://american.zoom.us/>.
- If using the app (recommended), use the "Sign in with SSO" option and enter american as the company domain (american.zoom.us).
- If you are prompted for your email, you must use your **non-student** address: [AU\\_email\\_ID@american.edu](mailto:AU_email_ID@american.edu)
- Do NOT use your [AU\\_email\\_ID@student.american.edu](mailto:AU_email_ID@student.american.edu) email address. It will not be recognized as part of the AU domain even if you created a free Zoom account with it.
- Do NOT use a personal zoom account or Google or Facebook to log in.

If you have any issues with activating the Zoom license (just signing in for the first time activates the license automatically), please email [helpdesk@american.edu](mailto:helpdesk@american.edu) or call 202-885-2550 for immediate assistance.

For online office hours, the waiting room is enabled, so you will need to wait for me to admit you to join the session. You will need to enable your audio and video as you join. Please turn on your video, if possible. If I am working with another student when you sign in, you may need to wait a bit and I will get to you as soon as possible. If I see that students from the same course are waiting while I am helping you, I may admit them at the same if I feel that it is appropriate and beneficial to discuss questions together as a group.

## COURSE COMPONENTS

### Class Structure

I am very much looking forward to meeting with you face-to-face later this semester! It is important that we create a supportive and engaging community where we can work and learn together. Classes will meet in our Zoom online classroom for at least the first three weeks. Beginning the week of January 31, we are scheduled to start meeting in our assigned classroom(s) during class time. Any changes to this timeline or class meetings throughout the semester will be clearly communicated on Canvas. Please remember that you are **required to wear an appropriate mask for the entirety of all face-to-face classes**. Class meetings will be a blend of lecture, class discussion, and independent discovery. I want you all to be involved during class and please do not hesitate to ask questions something is unclear to you. For online meetings, you may use the “raise hand” function or type a question in the chat box. I will also use Breakout Rooms to allow you to discuss course material with your peers and to ask me questions in a smaller group setting. **You are expected to attend all class meetings and actively participate in group discussions.** If a reasonable occurrence prohibits you from attending class, please contact me prior to the class meeting (or as soon as possible). It is your responsibility to make up the work covered during a missed class.

By the beginning of each week, I will announce important details for the upcoming week. Daily agendas for class meetings, readings, class preparations, and graded work that will be due for the upcoming week will all be posted in **Modules** on Canvas. Please take time to **prepare** for class **before** each the meeting time. **At a minimum**, it is expected that you read over the assigned chapter(s) from the text, prepare the posted handouts that outline the notes and any discussion problems (this means that you need to print them if you wish to have a printed copy for class), and review any other supplementary materials that I mention (PowerPoints, videos, recordings, etc.). After each class, I will post the PowerPoint slides and other supplementary materials used during class time. I will generally record whole-group portions of our online sessions for those who may wish to review them later (look in the **Media Gallery** on Canvas).

At the end of most classes (the last 60-75 minutes), we will have an **in-class lab assignment** requiring the utilization of R. I expect the majority of work to be completed during class time. The lab assignments will be posted on Canvas and must be submitted via Canvas by the due date (typically 11:59 PM that day). While you may discuss the labs with classmates, they are individual assignments, and you are responsible for composing your own submission and submitting your own work. The labs are open note. They will generally focus on what was covered in that day’s class but may include previous topics. You must attend class on a lab day and submit the lab by the designated due date and time to receive credit (unless you have made a previous arrangement with me).

### Participation

If you attend the class meeting on a given day **AND** actively participate, you will receive full participation credit for that day. Active participation includes answering questions, asking questions, and engaging with me and classmates while working on labs and other examples. However, in the event that you need to miss class for health or other reasons, please contact me as soon as possible and plan to attend office hours or check-in with me via email to discuss what you have missed and need to make up.

## Assignments & Mini-Projects

During the semester I will assign and collect assignments most weeks. All assignments will be announced on Canvas with a reminder of the due date and any other important details. Anticipated due dates are listed on the “Course Schedule on Canvas and will be updated each week. Make sure that you read the directions for each assignment carefully.

A typical assignment will include a few computational and/or conceptual problems that require some work by hand and a series of applied mini-projects with realistic data sets to complete with computer software. Some problems will be required for STAT 615 students only (STAT 415 students are welcome to complete these problems for extra-credit). A consistent effort to complete all the assigned problems is essential for learning statistical methods and for the successful performance in this course.

You may receive assistance from me, tutors, and other students in the class, but your submission must be composed of your own thoughts and words. Failure to do so is a violation of [AU’s Academic Integrity Code](#). Direct copying of assignments or solutions from anyone or anywhere is plagiarism. **I will not generally accept late work and will only do so on rare occasions when you have made an arrangement with me before the due date and time.**

## Exams

We will have **TWO** exams. Please see the “Course Schedule” on Canvas for the in-class exam dates for the Midterm Exam and the University designated Final Exam Period.

- **Midterm Exam:** This exam will cover topics related to Chapters 1-4.
- **Final Exam:** This exam will focus on topics from the second part of the course (emphasis on topics related to Chapters 5-11). Given that the topics in the second part of the course are heavily based on the topics discussed in the first part, the exam will be essentially cumulative.

I expect that each exam will have a take-home portion and an in-class portion. **They are not to be discussed with anyone**, except the instructor. You will be required to sign a pledge with all exam submissions acknowledging what resources are permitted and adherence to [AU’s Academic Integrity Code](#). I will provide you with this pledge and more specific instructions prior to each exam. You will receive a review sheet and I will discuss exam details during the class before each exam. The review sheets are designed to guide you in studying for the exam, but do not expect them to be a replica of the exam. Any material covered in class, on assignments, and on labs is “fair game.” **No make-up exams will be given unless you have an excused absence discussed with me in advance of the exam date and time.**

## GRADING

Your final grade will be determined by:

**Lab Assignments** (20%)

**Participation** (5%)

**Assignments & Mini-Projects** (25%)

**Exams** (50% total; 25% each)

**\*\*I do not generally post all grades on Canvas. Please visit my office hours or email me if you would like to see or discuss your grade at any point during the course. \*\***

## ASSISTANCE & SUPPORT

Before receiving any assistance, please make sure that you have read the notes and text and that you have made a fair attempt at the problem. You have many excellent resources to use for assistance outside of class:

1. Always feel welcome to talk to me during my **office hours**. Office hours are often busy so please come prepared with specific questions. If you are having **ANY** trouble with the class, please talk to me about it as soon as possible. Do not wait until it is too late. Remember that I try to reserve at least one hour per week outside of my scheduled hours for appointments, so please contact me via email if you would like to talk at a different time.
2. You are also encouraged to ask me questions via **email**. Please do not wait until the last minute to ask important questions pertaining to assignments or exams. I will do my best to respond to you promptly within normal business hours but may not be able to do so at other times.
3. Talk to your **peers**! Feel free to work with your classmates on classwork and assignments (not exams!). Just make sure that you write down the solutions in your own words, just as you do in class.
4. This semester the University is offering **tutoring services** via the [Math & Stats Program](#) (Statistical Software Support and Graduate Student Support are the applicable resources for our class). "The Math & Stats Program provides FREE, drop-in tutoring to American University students in mathematics courses, statistics courses, and in statistical software programs such as Excel, Python, R, SAS, SPSS, SQL, StatCrunch, and Stata." Remember that the tutors are there to assist you, not to do your work for you. To see more details, including locations and hours, click on the link above. Support will begin Wednesday January 19, 2022.
5. We have a **Graduate TA** who is working with all sections of STAT 415/615 this semester. I will include the TA's contact information and details about weekly office hours on our Canvas homepage.
6. **Additional support services** are available that may assist you in successfully completing the course requirements.
  - [Academic Coaching, Academic Resource Library & Learning Support Services](#)
  - The [Counseling Center](#) (X3500, MGC 214) "These are challenging times - please know that the Counseling Center is here for you! Starting August 16, 2021, we will be providing both in-person and virtual services."
  - The [Dean of Students Office](#) (x3300, Butler Pavilion 408) "supports student learning through programs and services that promote growth and development, communicate the values and standards of the AU community, and advocate for students' needs."
  - [Center for Diversity & Inclusion](#) (X3651, MGC 201) is dedicated to enhancing LGBTQ, Multicultural, First Generation, and Women's experiences on campus and to advance AU's commitment to respecting & valuing diversity by serving as a resource and liaison to students, staff, and faculty on issues of equity through education, outreach, and advocacy.
  - [OASIS: Confidential Victim Advocacy](#) (X3276)-A program of the Health Promotion and Advocacy Center, OASIS (the Office of Advocacy Services for Interpersonal and Sexual Violence) provides free and confidential victim advocacy services for American University students who are impacted by all forms of sexual violence (e.g. sexual assault, rape, dating or domestic violence, sexual harassment, or stalking)--either directly or indirectly.
  - [International Student & Scholar Services](#) (X3350, Butler Pavilion 410) has resources to support academic success and participation in campus life including academic counseling, support for second language learners, response to questions about visas, immigration status and employment and intercultural programs, clubs, and other campus resources.

### COVID-19 Health & Safety-Related Resources

- **AU Covid-19 Resources Website:**  
<https://www.american.edu/coronavirus/>
- **Frequently Asked Questions**  
<https://www.american.edu/coronavirus/faq.cfm>
- **Health and Safety Directives**  
<https://www.american.edu/policies/safety-risk-management/communicable-diseases-policy.cfm>

## IMPORTANT NOTES

- I expect you to be courteous to me and your fellow classmates both inside and outside of the classroom. Cell phones need to be silenced and put away during class. Computers should only be used for classroom activities. Please save texting, typing/sending emails, checking social media, etc. for outside of class time. Any correspondence pertaining to the course needs to be handled in a respectful manner.
- Plan to spend several hours after each class to prepare for the next class and upcoming assignments (this should be at least 5 hours OUTSIDE of class time per week.)
- **Accommodations:** Please let me know as soon as possible if you have any special needs that require accommodations and provide me with your accommodations letter from ASAC. To register with a disability or for questions about disability accommodations, contact the Academic Support and Access Center at 202-885-3360 or [asac@american.edu](mailto:asac@american.edu). For more information, visit AU's [Disability Accommodations web page](#).
- A grade of **incomplete** will only be given under extreme circumstances and will not be granted to any student who is failing.
- In the event of an **emergency**, please refer to the [AU Web site](#) and the AU information line at (202) 885-1100 for general university-wide information. If class is cancelled or plans are changed for **ANY** reason, I will communicate with you via email and Canvas to let you know what work, reading, etc. you should do.
- Violations of the **Academic Integrity Code** will not be treated lightly, and disciplinary action will be taken should violations occur. This includes cheating, fabrication, and plagiarism. Please be sure that you are familiar with [AU's Academic Integrity Code](#), as I am required to report any cases of academic dishonesty to the dean of CAS.
- **Sharing of Course Content:** Students are **not** permitted to make visual or audio recordings, including live streaming, of classroom lectures or any class related content, using any type of recording devices (e.g., smart phone, computer, digital recorder, etc.) unless *prior permission* from the instructor is obtained, and *there are no objections* from any of the students in the class. If permission is granted, personal use and sharing of recordings and any electronic copies of course materials (e.g., digital handouts, formulas, lecture notes and any classroom discussions online or otherwise) is limited to the personal use of students registered in the course and for educational purposes only, even after the end of the course. Exceptions will be made for students who present a signed Letter of Accommodation from the Academic Support and Access Center.

To supplement the classroom experience, lectures may be audio or video recorded by faculty and made available to students registered for this class. Faculty may record classroom lectures or discussions for pedagogical use, future student reference, or to meet the accommodation needs of students with a documented disability. These recordings are limited to personal use and may not be distributed (file share), sold, or posted on social media outlets without the written permission of faculty.

Unauthorized downloading, file sharing, distribution of any part of a recorded lecture or course materials or using information for purposes other than the student's own learning may be deemed a violation of [American University's Student Conduct Code](#) and subject to disciplinary action (see Student Conduct Code VI. Prohibited Conduct).

- **Acknowledgment:** Thank you to Professor Jun Lu, Professor Michael Baron, and Professor Zois Boukouvalas at American University for sharing language contained within this syllabus, as well as notes and other materials previously used for this course.