APSTA-GE 2003: Intermediate Quantitative Methods

NYU values an inclusive and equitable environment for all our students. I hope to foster a sense of community in this class and consider it a place where individuals of all backgrounds, beliefs, ethnicities, national origins, gender identities, sexual orientations, religious and political affiliations, and abilities will be treated with respect. It is my intent that all students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource and strength. If this standard is not being upheld, please feel free to speak with me.

Class location and time
Lectures:
Mon - 4:55pm-7:25pm
(SILV room 401: Silver Center, 100 Washington Square East)

Lab sections:
Lab 1 (Nora): Thu - 9:30am-10:45am in EDUC 1080
Lab 2 (Zhuojun): Thu - 11am - 12:15pm in EDUC 1080
(EDUC 1080: Education Building, 35 West 4th St)

Lectures and Lab sections will take place in-person, although accommodations will be made for students that miss class for approved reasons, e.g., illness or religious observances.

Contact information
Instructor: Ravi Shroff
Office Hours: Wed - 4:30-5:30pm (or by appointment), in person (Kimball Hall room 515E) + zoom (via Brightspace)

Course Description and Goals
This course is intended to introduce students to regression techniques from a simulation-based perspective, with an emphasis on applications rather than mathematical theory. Topics will include: linear regression with a single predictor and multiple predictors; linear regression assumptions, diagnostics, and interpretation; prediction and inference; transformations and interactions; analysis of variance (ANOVA); and logistic regression. The programming language R will be used throughout the course. The course is appropriate for graduate students interested in learning techniques for analyzing quantitative data.

Course Prerequisites

APSTA-GE: 2001-2002 or equivalent.

Course Format

Each lecture will meet for up to 150 minutes per week with a short break in the middle. Each meeting may include both lectures and in-class group work. Lecture slides and course materials will be available on the course website on Brightspace. In addition to the weekly lecture, attendance in weekly lab sections is <u>strongly encouraged</u>. The lab will be led by a Course Assistant, and will provide additional demonstrations of lecture material and assistance with homework assignments.

Course Grading

The grade for this course will be based on:

1. Participation **(10%)**. Please be engaged! You can show your engagement by attending class, lab section, and office hours, and completing in-class group work. You can also show engagement by asking and answering questions during lecture, on the class forum, or in office hours (please keep track of the ways in which you participated, as I will ask for this at the end of the semester to help determine your grade). <u>Do not use your phone during class, and limit the use of laptops/tablets except as instructed.</u>
2. Homework assignments **(70%).** Assignments reinforce and extend understanding of concepts covered in class. These assignments will include questions that assess conceptual understanding as well as hands-on modeling exercises in R. You will be expected to clearly and concisely explain your results in writing. <u>Doing the homework is essential for succeeding in this class and learning the material.</u>
3. A final exam **(20%)**. This will take place in-class during the last scheduled meeting time. You are allowed to bring one handwritten sheet of notes (front and back), as well as a scientific calculator.

Grading Scheme

Specific grading criteria for each type of assignment will be provided. The following thresholds indicate a numerical grade *sufficient* to guarantee the corresponding letter grade; actual letter grades assigned will depend on the distribution of final numeric grades in the class (i.e., I may grade more leniently than this rubric suggests, but I won't grade more harshly):

93%: A
90%: A-
87%: B+
83%: B
80%: B-
77%: C+
73%: C
70%: C-
67%: D+
63%: D

60%: D-
<60%: F

Deadlines and Homework Policies
Each of the 11 homework assignments should be submitted on Brightspace before the beginning of the lecture (4:55pm) on the due date. Your lowest-scoring assignment will be dropped when calculating your homework grade. Late problem sets will be reduced according to the following schedule:

- If turned in within 24 hours of the deadline, 5 percentage points will be deducted; else
- If turned in within 48 hours of the deadline, 10 percentage points will be deducted; else
- If turned in over 48 hours after the deadline, no credit will be given for the problem set.

If you think you may be ill, you do not need to provide additional information or documentation to the instructor, and you will be given an extension corresponding to the number of days you were ill. Barring illness, exceptions to the policy above are granted only in extreme circumstances and require written documentation. Examples include a documented accommodation approved by the Moses Center for Student Accessibility or hospitalization. Poor time management does not count as an exceptional circumstance.

In general, “A” work requires: correct numerical answers, correct implementations of methods, accurate and understandable interpretations of any results, and clear explanations regarding the connections of any results to the scientific or real-world phenomenon being examined. All work is to be submitted online and should be professional in appearance; in particular, sentences should be complete, and answers must be clear and coherent.

You should work on the problem sets by yourself. You may discuss problems with your classmates, the course assistants, and the professor, but your submitted work must be your own (please see the Academic Integrity statement here). In particular, you may not copy code from your classmates; this will be deemed plagiarism and sanctioned according to NYU guidelines.

Required Textbooks
[RAOS] Regression and Other Stories - Gelman/Hill/Vehtari (free online pdf)
[ALR] Applied Linear Regression - Weisberg (free online pdf)

Course Outline and Required Readings
A detailed week-by-week course outline, including required readings and assignment due dates, is at the end of this syllabus. This outline may change during the semester.

Academic Integrity
All students are responsible for understanding and complying with the NYU Steinhardt Statement on Academic Integrity. A copy is available here.

Access and Accommodations:

New York University is committed to ensuring equal educational opportunity and accommodations for all students. Students should contact the Moses Center for Student Accessibility at (212) 998-4980. The Center will work with students to determine appropriate and reasonable accommodations that support equal access.

Course Outline (subject to change):

Date	**Subject**	**Topics**	**Reading**
Lecture 1 9/12/2022	Intro and background 1 **[HW 1 assigned]**	Overview; data and measurement	RAOS ch. 1.1-1.5, ch. 2, ch. 3, Appendix A.1-A.7; ALR ch. 1.1-1.3
Lecture 2 9/19/2022	Intro and background 2 **[HW 2 assigned]**	Inference; simulation **[HW 1 due]**	RAOS ch. 4.1-4.3, ch. 5.1-5.2
Lecture 3 9/26/2022	Simple linear regression 1 **[HW 3 assigned]**	Intro to the simple linear model **[HW 2 due]**	RAOS ch. 6, ch. 7
Lecture 4 10/3/2022	Simple linear regression 2 **[HW 4 assigned]**	The simple linear model, continued **[HW 3 due]**	RAOS ch. 7
Lecture 5 10/11/2022 (**TUESDAY**)	Simple linear regression 3 **[HW 5 assigned]**	Fitting models and inference **[HW 4 due]**	RAOS Ch. 8.1 (skip last two subsections), 8.2, 8.3; ALR Ch. 2 (skim intro and sections 2.1-2.6.2)
Lecture 6 10/17/2022	Simple linear regression 4/ Multiple regression 1 **[HW 6 assigned]**	Prediction, and introduction to multiple regression. **[HW 5 due]**	ALR 2.6.3-2.6.4 RAOS Ch. 9.2 (intro, first and last subsection) RAOS ch. 10.1, 10.2
Lecture 7 10/24/2022	Multiple regression 2 **[HW 7 assigned]**	Introduction to multiple regression, continued. **[HW 6 due]**	RAOS ch. 10.3, 10.4, 10.7, 10.9 recommended: -ALR ch 5.1, 5.2, 5.3 Optional: -ALR ch 3.2-3.4.5 -ALR appendix A.6
Lecture 8 10/31/2022	Multiple regression 3 **[HW 8 assigned]**	Assumptions, diagnostics, and evaluation **[HW 7 due]**	RAOS: Ch 11.1-11.5, 11.6 (skip last subsection), 11.7 Optional: ALR Ch 9.1(intro, 9.1.1, 9.1.4, 9.1.5), 9.6
Lecture 9 11/7/2022	Multiple regression 4 **[HW 9 assigned]**	Transformations **[HW 8 due]**	RAOS: 12.1-12.5, 12.6 (only intro and first subsection)

			Optional: ALR 8.1 (skip 8.1.3)
Lecture 10 11/14/2022	Logistic regression 1 **[HW 10 assigned]**	Basics of logistic regression **[HW 9 due]**	RAOS: Ch 13.1 (skip last subsection), 13.2, 13.3 (intro, first, sixth, last subsections), 13.4 (skip last subsection), 13.5 (intro, first subsection), 13.7 (ignore discussions of ‘log score’). Optional: ALR: Ch 12.2.1
Lecture 11 11/21/2022	Logistic regression 2	Applications of logistic regression **[HW 10 due]**	RAOS: Ch 14.1, 14.2, 14.4-14.6 (ignore discussions of ‘log score’ and ‘LOO log score’)
Lecture 12 11/28/2022	Additional topics **[HW 11 assigned]**	Assorted topics, e.g., post-stratification, imputation, weighted regression	RAOS ch. 17, ch 10.8
Lecture 13 12/5/2022	Regression in practice	Examples of regression in research **[HW 11 due]**	
(no lecture) 12/12/2022	In-class final exam		