# APSTA-GE 2004: Topics in Multivariate Analysis

***Note: 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, strength and benefit. clinton.brownley@nyu.edu If this standard is not being upheld, please feel free to speak with me.***

**Class location and time**

Lecture:
Tuesdays from 4:55pm-7:25pm Eastern (i.e., New York) time

Lab sections:
Lab 1: Tuesdays from 7:45pm-9:00pm Eastern (Martha)
Lab 2: Wednesdays from 4:55pm-6:10pm Eastern (Annika)

Note that Lectures will take place remotely (virtually via Zoom), but Lab sections will take place in-person, although accommodations will be made for students that miss class due to, e.g., illness or religious observances.

**Contact information**

Instructor: Clinton Brownley
Email: clinton.brownley@nyu.edu
Office Hours: Wednesdays, 1-2pm Eastern (i.e., New York) time

**Course Description and Goals**

This course is intended to further students' exposure 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); global tests for coefficients (F-tests); contingency tables; and information criteria and model comparison. 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: 2003 or equivalent.

**Course Format**

We will meet for up to 150 minutes per week. 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 strongly encouraged. Each lab will be led by a TA, 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 do your best to 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 your 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*).
2. Individual homework assignments **(90%).** 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. *Doing the homework is essential for succeeding in this class and learning the material!*

**Grading Scheme**

Specific grading criteria for each type of assignment above will be provided. The following thresholds indicate a numerical grade *sufficient* to guarantee the corresponding letter grade. However, final letter grades assigned will depend on the distribution of final numeric grades in the class (in particular, 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 6 homework assignments for this class is to be submitted on Brightspace *before* the beginning of the lecture (4:55pm Eastern time) on the due date. 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 from the problem set grade.
- If turned in **after 24 hours, but within 48 hours** of the deadline, 10 percentage points will be deducted from the problem set grade.
- If turned in **over 48 hours** after the deadline, no credit will be given for the problem set.

If you think you may be feeling ill, note that 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 of exceptional circumstances include a learning disability (documented by NYU in the form of a written letter from 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 assistant, 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 and Recommended Readings/Text**
[RAOS] Regression and Other Stories - Gelman/Hill/Vehtari (required)
[SR] Statistical Rethinking, 2nd Ed - McElreath (recommended)

**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. However, 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**

| Date | Subject | Topics | Reading |
|---|---|---|---|
| Lecture 1<br>1/24/2022 | Introduction<br>**[ HW 1 assigned ]** | Overview; Review of regression | RAOS 1.5-1.6; 4.2, 4.4-4.5; Ch. 6-7; Ch 10.1-10.4; Ch 11.1-11.4 |
| Lecture 2<br>1/31/2022 | Regression<br>**[ HW 2 assigned ]** | Model fitting, interpretation; global tests of model fits (F-tests)<br>**[ HW 1 due on 1/31 ]** | RAOS 3.4; Ch 8-9; Ch 10.7; Ch 11.1-11.4,11.6; Ch 12.1-12.5; Ch 16.4 |
| Lecture 3<br>2/7/2022 | Distributions and CLT<br>**[ HW 3 assigned ]** | Distributions, CLT<br>**[ HW 2 due on 2/7 ]** | RAOS 3.5-3.6; Ch 4; Ch 5 |
| Lecture 4<br>2/14/2022 | ANOVA and regression<br>**[ HW 4 assigned ]** | ANOVA and regression<br>**[ HW 3 due on 2/14 ]** | RAOS Ch 7.3; Ch 9.1-9.2; Ch 10.1-10.5; Ch 11.2 |
| Lecture 5<br>2/21/2022 | Model evaluation<br>**[ HW 5 assigned ]** | Model evaluation<br>**[ HW 4 due on 2/21 ]** | RAOS Ch 7.2; Ch 11.6-11.8 |
| Lecture 6<br>2/28/2022 | Contingency tables and regression<br>**[ HW 6 assigned ]** | Model fitting, interpretation; chi-squared tests<br>**[ HW 5 due on 2/28 ]** | RAOS Ch 15; Ch 9.1-9.2; Ch 10.1-10.4; Ch 11.2; Ch 12.4, 12.5 |
| Lecture 7<br>3/7/2022 | Additional topics | Multivariate normal; covariance matrix<br>**[ HW 6 due on 3/7 ]** | RAOS Ch 3; Ch 5; Ch 11.8 |