AANT 601: ADVANCED QUANTITATIVE METHODS IN ANTHROPOLOGY
SPRING 2023 (CLASS 8539)
MONDAY & WEDNESDAY 11:40 AM-1:00 PM, MASSRY CENTER B 004

Instructor: Adam Gordon, Ph.D. Office: AS 246
email: agordon@albany.edu Office hours: Mondays, 2:00 to 4:00 pm, or by appointment.

Prerequisites: Knowledge of univariate statistics is required for this course, and knowledge of basic bivariate statistics is strongly encouraged.

Course Objectives: This course is designed to provide a basic knowledge of multivariate data visualization, analysis, and hypothesis testing as applied to data sets typically found in anthropological research. In addition, resampling techniques such as the jackknife, bootstrap, and randomization will be covered. By the end of the course, students should be familiar with these methods and be able to implement them using the statistical programming language *R*.

Course Website:
Course materials such as readings, data sets for homework exercises, grades, and this syllabus will be posted on Blackboard. In addition, course announcements such as amendments to this syllabus will be posted on Blackboard.

Required Textbook:

Manly BFJ and Navarro Alberto JA. 2017. *Multivariate Statistical Methods: A Primer, fourth edition*. Chapman & Hall/CRC, New York.

The textbook will be supplemented with other required readings that will be made available via Blackboard.

Statistical Software:
We will be using the statistical programming language *R* in this course. Prior to the second class meeting, all students must download and install *R* from the *CRAN* website (cran.r-project.org/) onto a computer that they will have regular access to. In addition, Windows users should download and install a text editor for *R* code that color-codes functions and highlights matching brackets (such a text editor is built-in for Mac users). I generally use the freely-available program Notepad++ (https://notepad-plus-plus.org/), but there are many programs available. *R Studio* (www.rstudio.com/) is also a popular option that combines text editing and a GUI for *R*.

Students with Disabilities:
If you require a disability-related academic accommodation for this class, please register with Disability Access and Inclusion Student Services (DAISS) as soon as possible and ask them to communicate with me regarding any reasonable accommodation for the course or instructions about physical access. Please be aware that DAISS will communicate directly with me regarding any modifications to the course absence policy for a specific student, and in the absence of such communication DAISS has instructed faculty to follow the stated absence policy in the course syllabus. For more information about "reasonable accommodation", please see DAISS's Reasonable Accommodation Policy:
http://www.albany.edu/disability/docs/RAP.pdf

Academic Integrity:
Academic dishonesty of any kind will not be tolerated in this course. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of academic dishonesty by others, submitting work of another person (or AI) or work previously used without informing the instructor, or tampering with the academic work of other students. Students who are found to be academically dishonest will receive academic sanctions as outlined in the university's Graduate Regulations and Degree Requirements: www.albany.edu/graduatebulletin/requirements_degree.htm#penalties

Grading: Final grades will be given as A-E.

Course Requirements

Attendance: This is a graduate course; as such, I expect everyone to show up for every meeting. Furthermore, the material in each class meeting builds on the material presented in earlier classes, even more so than is the case in many other courses, so it is imperative that you attend every class. I will allow one absence without penalty. Beyond the first absence I will deduct five percentage points from the overall final grade in the course for each missed class; e.g., if a student misses three classes and would have otherwise received 95% overall in the course, they will instead receive 85% overall for the course. I will allow excused absences in the case of religious holidays (per New York State Education Law, Section 224-A), and may allow them in cases of documented illness, professional conferences, and possibly other activities, but you must talk to me about these events with as much advance notice as possible.

Homework Exercises: In order to ensure that you understand the material covered in class and do not fall behind, there will be regular homework exercises throughout the semester. Unless otherwise stated, the assignments will be due the next class period after they are handed out. Because I provide online answers to the homework assignments and go over those answers as soon as the assignments are turned in, I generally do not allow late assignments to be turned in. However, if you don't complete your homework for some reason, please talk to me about it.

Exam: There will be one exam in the second half of the semester. Students may be expected to work through simple calculations on some questions and will be expected to be able to describe how particular analyses work, how to interpret results of various analyses, and how to choose and set up an appropriate analysis for a given situation.

Poster: Each student will be required to analyze a data set of their own, a data set made available by a faculty member, or a publicly-available data set. The student will be expected to define the questions to be asked through background reading, develop the appropriate methodology, run the analysis, and present and discuss the limitations and results. Analyses may, and probably should, include univariate statistics, but must also include some form of multivariate analysis (*i.e.*, one or more of the methods addressed in this course). These analyses will be presented as a poster session at the end of the semester. Grades will be assessed on the basis of correctness, thoroughness, presentation, originality, neatness, *etc*. **Poster topics must be cleared with me by March 1st.**

Components of Overall Course Grade:
Homework exercises: 40% Exam: 20% Poster presentation: 40%

Class Structure

Class Content: In most classes I'll be presenting material in multiple ways: handwritten material on a whiteboard, *R* code that I will draw from that I'll provide in advance of each class, and a view of output in *R*. Be prepared to take notes, and you may want to have *R* open during class to follow along with any code that day, although it's not necessary to run code during class time.

Preparation for the First Day: Before the first day of class, please try to download and install *R* from the *CRAN* website (http://cran.r-project.org/) onto your computer. You don't need *R* for the first day, but I can talk you through any problems you encounter if you try to install it before the first day.

MAJOR DEADLINES

Wednesday, March 1st:	Meet with me by this date to discuss poster topic
Wednesday, April 12th:	Exam
Monday, May 1st:	Poster presentations

Course Schedule

Note about the schedule: In the past we've held the poster presentations on the reading day after the last day of classes so that everyone in the department could come by to see the students' work. Currently the presentations are scheduled for the final day of class. We'll talk in class about whether everyone is comfortable with the reading day option. Also, note that this schedule may be adjusted later in the semester.

Week 1

W 1/18 Introduction and review of univariate statistics

Week 2

M 1/23 Review of bivariate statistics: Regression
Reading: Motulsky H. 1995. Simple linear regression. In: *Intuitive Biostatistics*. Oxford University Press, New York. pp. 167-180.
Recommended:
Warton DI, Wright IJ, Falster DS, Westoby M. 2006. Bivariate line-fitting methods for allometry. *Biological Reviews*. 81: 259-291.
Smith RJ. 2009. Use and misuse of the reduced major axis for line-fitting. *American Journal of Physical Anthropology*. 140: 476-486.

W 1/25 Displaying multivariate data (and using R)
Reading: Manly & Navarro Alberto, Chapters 1 & 3

Week 3

M 1/30 Matrix Algebra
Reading: Manly & Navarro Alberto, Chapter 2

W 2/1 Matrix Algebra

Week 4

M 2/6 Tests of significance with multivariate data: Multiple regression
Readings:
McDonald, JH. 2009. Multiple regression. In: *Handbook of Biological Statistics, 2nd ed.* Sparky House Publishing, Baltimore, MD. (www.biostathandbook.com/multipleregression.html)
Pages 521-544 in Wackerly DD, Mendenhall W, Scheaffer RL. 1996. *Mathematical Statistics with Applications*. Wadsworth: New York.

W 2/8 Tests of significance with multivariate data: ANCOVA and nested models
Reading: McDonald, JH. 2009. Analysis of covariance. In: *Handbook of Biological Statistics, 2nd ed*. (www.biostathandbook.com/ancova.html)

Week 5

M 2/13 Tests of significance with multivariate data: Hotelling's T^2
Reading: Manly & Navarro Alberto, Chapter 4

W 2/15 Tests of significance with multivariate data: MANOVA
Reading: Manly & Navarro Alberto, Chapter 4

Week 6

M 2/20 Measures of distance, similarity/difference indices, tests of significance with distance data: Randomization and the Mantel test
Reading: Manly & Navarro Alberto, Chapter 5

W 2/22 Tests of significance with distance data: Levene's test and Van Valen's test
Reading: Van Valen L. 2005. The statistics of variation. In: *Variation*, Hallgrimsson B, Hall BK, eds. New York: Elsevier. pp. 29-47.

Week 7

M 2/27 Principal components analysis
Reading: Manly & Navarro Alberto, Chapter 6

W 3/1 Principal components analysis **(Poster topics must be cleared by this date)**

Week 8

M 3/6 Discriminant function analysis
Reading: Manly & Navarro Alberto, Chapter 8
Recommended:
Cardini A, O'Higgins P, and Rohlf FJ. 2019. Seeing distinct groups where there are none: spurious patterns from between-group PCA. *Evolutionary Biology*. 46:303–316.

W 3/8 Discriminant function analysis

Week 9

M 3/13 NO CLASS (SPRING BREAK)

W 3/15 NO CLASS (SPRING BREAK)

Week 10

M 3/20 Cluster analysis
Reading: Manly & Navarro Alberto, Chapter 9

W 3/22 Cluster analysis

Week 11

M 3/27 Canonical correlation analysis
Reading: Manly & Navarro Alberto, Chapter 10

W 3/29 Canonical correlation analysis

Week 12

M 4/3 Multidimensional scaling and ordination
Reading: Manly & Navarro Alberto, Chapters 11 & 12

W 4/5 Multidimensional scaling and ordination

Week 13

M 4/10 Review session for exam

W 4/12 **EXAM**

Week 14

M 4/17 R workshop
Reading: Manly & Navarro Alberto, Chapter 1 Appendix

W 4/19 Resampling methods: Randomization
Reading: Manly BFJ. 2007. Randomization. In: *Randomization, Bootstrap and Monte Carlo Methods in Biology, third edition*. Chapman & Hall/CRC, New York. pp. 1-28.

Week 15

M 4/24 Resampling methods: Jackknife
Reading: Manly BFJ. 2007. The Jackknife. In: *Randomization, Bootstrap and Monte Carlo Methods in Biology, third edition*. Chapman & Hall/CRC, New York. pp. 29-40.

W 4/26 Resampling methods: Bootstrap
Reading: Manly BFJ. 2007. The Bootstrap. In: *Randomization, Bootstrap and Monte Carlo Methods in Biology, third edition*. Chapman & Hall/CRC, New York. pp. 41-80.

Week 16

M 5/1 Poster presentations