TEXAS A&M UNIVERSITY

Paleoecological Community Analysis

Course title and number	GEOL 651 Paleoecological Community Analysis
Term	Spring 2020
Meeting times and location	Lecture: Tuesday/Thursday 12:45-2:00 PM in Halbouty 174

Course Description and Prerequisites

Description: Quantitative analysis of multivariate paleoecological community data; measurement of diversity; cluster analysis; gradient analysis by standard and canonical ordination techniques.
Prerequisite: A basic course in statistics or approval of instructor. (Graduate students are routinely approved.)

Learning Outcomes

Students who complete this course should be able to:

- Perform common ecological analyses in R.
- Apply quantitative techniques in their own research.
- Interpret and critically evaluate ecological analyses performed by others.

Instructor Information

Name	Dr. David Bapst
Email address	dwbapst@tamu.edu
Office location	Halbouty 169
Office Hours	TBD

Software or Resource Material

Required Software

Students need access to their own computer which they can bring to class , and to install the R interpreter (obtain from CRAN: https://cran.r-project.org), the integrated development environment (IDE) Rstudio (obtain from the Rstudio website, https://www.rstudio.com/products/rstudio/download), and a spreadsheet program (Excel, LibreOffice Calc, etc). Both R, Rstudio, and LibreOffice are available for free.

No textbooks are required, however you may find the following volumes useful in your studies:

Borcard et al., 2011. Numerical Ecology with R. Springer. 306 pp.

Crawley, M.J., 2013. The R Book. John Wiley & Sons, West Sussex, 1051 p.

Hammer and Harper, 2006. Paleontological Data Analysis. Wiley-Blackwell. 351 p.

Legendre and Legendre, 2012. Numerical Ecology, 3rd edition. Elsevier. 1006 pp.
(There are many reprints of this volume - older versions are also good!)

Patzkowsky and Holland, 2012. Stratigraphic Paleobiology: Understanding the Distribution of Fossil Taxa in Time and Space. University of Chicago Press. 256 pp.

Sneath and Sokal, 1973. Numerical Taxonomy: Principles and Practice of Numerical Classification. W H Freeman and Co. 588 pp.

Sokal and Rohlf, xxxx. Biometry: The Principles and Practice of Statistics in Biological Research. Newest version is 2011. 1994 edition is also good.

Zar, 2009. Biostatical Analyses, 5th edition. Pearson. 960 pp.

Grading and Attendance Policies

Standard Letter Grading Scale: A = 90-100%, B = 80-89%, C = 70-79%, D = 60-69%, F = <60%

The final course grade will be based upon:

Discussion, Participation & Leadership	**10%**
Paper Discussion	**10%**
R Worksheets	**20%**
Term Project - Final Paper	**40%**
Submission of Preliminary Drafts	**5%**
Project Proposal and Preliminary Dataset	**5%**
In Class Presentations	**10%**

Grades in this class will be based on class participation, paper discussions, a series of individual R-programming assignments, and a final project. The final project involves a short proposal, a preliminary dataset, a series of working drafts, and two in-class presentations. See the end of this syllabus for more details on the final project.

Worksheet assignments will begin in class as tutorials demonstrating a particular set of approaches in R, with additional tasks for students to complete outside of class. Assigment reports must be submitted as individual reports, but students can choose to work on the assignments as a group.

Paper discussions will be assigned during the second week of class, with each student being assigned a class day to lead discussion on a journal article. Students are expected to prepare a 1-2 page bulleted summary of the main points of the paper, and send to the instructor early enough for paper copies to be printed.

Students can **demonstrate leadership** in the course by being an active participant in active coding exercises, by being involved in classroom discussions about lecture topics, and by providing anonymous feedback to their peers after in-class presentations. All students are expected to participate in class activities and to be respectful of others and their ideas. Attendance is mandatory with allowances for excused absences with proper documentation in accordance with http://student-rules.tamu.edu/rule07.

Americans with Disabilities Act (ADA)

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information, visit https://disability.tamu.edu.

Academic Integrity

For additional information please visit: http://aggiehonor.tamu.edu

"An Aggie does not lie, cheat, or steal, or tolerate those who do."

Tentative Schedule of Lecture and Worksheet Topics

Week	Date	Lecture Topic	Course Assignments Due
1	Jan 14 (T)	Introduction, Multivariate Data for Ecology and the Environment	
	Jan 16 (TH)	Using the R Terminal & RStudio	*Install R before class*
2	Jan 21 (T)	Loading Datasets and Manipulating Tables in R	**Submit Project Proposals**
	Jan 23 (TH)	Math vs. Philosophy in Data Transformations	
3	Jan 28 (T)	Transforming and Cleaning Data in R (W1)	
	Jan 30 (TH)	Probability and Sampling	**Submit Prelim Data & Description**
4	Feb 4 (T)	Bootstrapping and Designing Typical Univariate Statistical Tests in R **(W2)**	Worksheet 1 Due
	Feb 6 (TH)	ANOVA, Chi-Square and Regressions	*Comments on Prelim Data returned*
5	Feb 11 (T)	Multiple and Logistic Regression in R **(W3)**	Worksheet 2 Due
	Feb 13 (TH)	Measuring Ecology – Diversity, Evenness	***Paper Discussion***
6	Feb 18 (T)	Dissimilarity Metrics and their Uses **(W4)**	
	Feb 20 (TH)	Cluster Analyses: Visualizing Dissimilarity	***Paper Discussion***
7	Feb 25 (T)	Cluster Analyses in R **(W5)**	Worksheet 4 Due
	Feb 27 (TH)	Ordinations in (Paleo)Ecology	***Paper Discussion***
8	March 3 (T)	Ordination in R – PCA, PCO **(W6)**	Worksheet 5 Due
	March 5 (TH)	Interpreting Ordinations and Cluster Analyses	***Paper Discussion*** **Submit Intro + Data Draft**
9	March 17 (T)	Ordination in R – NMDS, DCA **(W7)**	Worksheet 6 Due *Comments on Intro + Data returned*
	March 19 (TH)	Direct Gradient Analyses	***Paper Discussion***
10	March 24 (T)	Ordination in R – CCA, RDA **(W8)**	Worksheet 7 Due
	March 26 (TH)	Classification with Ordinations	***Paper Discussion*** **Submit Methods Draft**
11	March 31 (T)	Ordination in R – LDA, CVA **(W9)**	Worksheet 8 Due
	April 2 (TH)	**Present:Term Project Progress Reports**	*Comments on Methods returned*
12	April 7 (T)	Classification and Regression Tree Analysis	Worksheet 9 Due ***Paper Discussion***
	April 9 (TH)	CART and Random Forest in R **(W10)**	
13	April 14 (T)	Factor Analysis & Latent Variables	**Submit Full Draft of Term Paper**
	April 16 (TH)	Structural Equation Modeling, & Path Analysis	Worksheet 10 Due
14	April 21 (T)	SEM in R, Final **Project Help**	
	April 23 (TH)	**Final Project Presentations**	Comments on Full Draft returned

FINAL TERM PAPER DUE LAST DAY OF CLASSES, APRIL 28TH

Term Project Data Requirements and Successive Drafts

This class requires a project-based term paper, centered on a research question selected by the student, involving the analysis of a multivariate dataset. Students are required to locate and obtain an appropriate dataset for their chosen question – perhaps from a publicly-available published dataset, unpublished data provided by their advisor or a collaborator, or data collected as part of their own research. Datasets must be large enough and detailed enough to address a worthwhile research question. **Datasets must have a minimum of 10 samples and more than one variable measured on each sample.** Addressing these research questions will require applying various analyses from throughout the course, and possibly beyond the covered course material.

During week 2, students must submit a paragraph proposing one or more potential research questions they might pursue for their term paper. During week 3, students must submit a preliminary data file, that meets the minimum requirements for the term paper, and a data 'read-me' describing the contents of the datafile, to the standards expected for a data appendix provided for a published paper.

Interim drafts of the term paper are due at three points during the semester. Each of these three drafts should have proper in-text citations and formatted references, include a file containing the current data set used for the project, regardless of whether it has been modified since the original data submission.

The first draft due, referred to as the 'intro & data' draft, is expected to contain (at minimum) the introduction, and a partial Methods section that describes the context and background of the data: where/when/how was the data collected, and describe any necessary treatments required to further analyze the data. The second 'methods' draft is expected to contain build off the former draft, but also describe the analytical approaches the student will apply in the Methods section. The third draft due should be relatively complete, containing results, discussion and any necessary figures or tables. Each draft will be graded relative to the final paper rubric, and grades for complete drafts (e.g. the third draft submitted) will lock in a students's scores as a 'minimum' grade, upon which students can only improve with successive submissions.

In-Class Project Presentations

During week 10, students will give in-class progress reports on the analyses they have chosen to apply, as well as methodological issues they have encountered, and on the last day of class, present their findings and interpretations to the class. The mid-semester presentation should cover the motivating research question, and describe the data and statistical approach to be used. Current questions or concerns about how they will analyze their data should be discussed as part the presentation, as well as explaining any difficulties encountered. Class presentations should be short, about 10-15 minutes in length, followed by taking questions from the audience. A presentation may involve projector slides, which should be supplied to the instructor before class, or the whiteboard can be used instead for any necessary visuals. Students in the audience can provide anonymous comments and feedback on the talks they see, using post-it notes.

Expected Term Paper Structure

The length of your paper depends on how much you have to say. Each member of a final project team will need to submit a separate term paper, formatted like a scholarly manuscript, covering the methods, and results of their project. A complete paper draft will have the following required sections:

Abstract (REQUIRED)

A concise, 1 paragraph summary of your study (e.g. questions, data, methods, results).

Introduction (REQUIRED)

Provide scientific context for your research question and background a reader would need to understand your study system and the importance of answering your research question. State your questions clearly and introduce how you will investigate them.

Methods (REQUIRED)

A complete description of the data and analyses you use, with justifications for why you chose those specific methods. Include references that support your decisions.

Results (REQUIRED)

A report of the results of your analyses, including reporting all necessary statistical values, and necessary supporting figures and tables. Interpretation of results should be minimized.

Discussion (REQUIRED)

An interpretation of your results in the context of the hypothesis you set out to test with reference to the published results of other workers. Address any analytical challenges, alternative interpretations, related your findings to the work of others, implications of your results to the field, and suggestions for future work that could improve your ability to answer your research questions.

Conclusions (OPTIONAL)

A concise summary of the "take-home" results, interpretations, and implications of your research. Similar to the abstract, but does not restate the study's setup.

References (REQUIRED)

Choose a consistent journal format. If uncertain which to use, use Paleobiology style.

Data Appendix (REQUIRED)

A file or table that contains all data you used for your paper. You must submit a data appendix with the draft of your Introduction and Methods draft, but you should update this appendix as you revise or add to your data over the course.