

ALS 6500 Multivariate Statistics for Agricultural and Life Sciences (3 credits)

Fall 2024

Tuesday: Period 3, 9:35am-10:25am (McCarty B 3096),

Thursday: Periods 3 and 4, 9:35am-10:25am (McCarty B 3086)

Instructor:

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Office hours: Tuesday 10:30-11:30, CALS Print Lab - McCarty Hall B 3082

Course Description:

This course provides students with a conceptual and practical understanding of the application of multivariate statistics in the life sciences. This course consists of a one period lecture and a two period computer lab (which may also contain a lecture) where students will put to use the techniques learned in lecture using R, the open source language for statistical computing and graphics. The **prerequisites** are an introductory statistics course and some experience with the R language (although the latter is not strictly necessary).

Course Objectives:

The overarching goals of this course is for students to gain proficiency in selecting, implementing, interpreting, and disseminating results from multivariate analyses. Specifically, students will **1)** learn the appropriate application of ordination, clustering, and discrimination techniques for different multivariate data structures and questions, **2)** learn how to import, manipulate, and analyze multivariate data in R, **3)** learn how to interpret and present results from multivariate analysis through figures and text.

Course Schedule:

Course Schedule is subject to change

| *Lecture # | Topic | Readings |
|------------|---|---|
| 1 | Intro to multivariate statistics | McGarigal et al., Ch. 1 |
| 2 | Multivariate Data: screening, transformations, distance measures | Borcard et al. , Ch. 2 & 3 (pgs. 31-45) |
| 3 | Ordination 1: Principal Components Analysis (PCA) | McGarigal et al., Ch. 2 (pgs.19-55) Peres-Neto et al. 2003 |
| 4 | Ordination 2: Principal Coordinates Analysis (PCoA) and Correspondence | Borcard et al. , Ch. 5 (pgs. 132-145) |

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|----------------------|--|--|
| | Analysis, Non-Metric Multidimensional Scaling (NMDS) | |
| 5 <i>Project Due</i> | Cluster Analysis 1: Clustering Methods | McGarigal et al., Ch. 3 (pgs. 81-104) |
| 6 | Cluster Analysis 2: Choosing Clustering Methods and Visualization | Borcard et al. , Ch. 4 (pgs. 53-79) |
| 7 | Testing for groups: perMANOVA, Mantel's test | McCune and Grace, Ch.24 & 27 |
| 8 <i>Project Due</i> | Discriminant Analysis/MANOVA | McGarigal et al., Ch. 4 |
| 9 | Classification and Regression Trees (Cart) | De'ath & Fabricius 2000 |
| 10 | Constrained Ordination | Borcard et al. , Ch. 6 |
| 11 | Constrained Ordination continued/Variance partitioning | Borcard et al. , Ch. 6 Cushman & McGarigal 2002 |
| 12 | Final Project Discussion | |
| 13 | Advanced Topics: TBD | TBD |
| 14 | Comparison of Techniques | McGarigal et al. Ch. 6 |

*each lecture has an associated lab

Important Dates:

Friday, September 20th: Project 1 is due.

Friday, October 11th: Project 2 is due.

Friday, December 6th: Final Project is due.

Course Readings:

Required:

*Borcard, D., Gillet, F., & Legendre, P. (2011). *Numerical ecology with R*. Springer.

Recommended:

McGarigal, K., Cushman, S., & Stafford, S. (2000). *Multivariate statistics for wildlife and ecology research*. Springer, New York.

*online version available for free from UF Library

Grading:

| | # of points | % of Grade |
|------------------------------------|--------------------|-------------------|
| Class attendance and participation | 30 | 25% |
| In-lab assignments | 30 | 25% |
| Projects (2) | 30 | 25% |
| Final Project | 30 | 25% |
| <i>Total Points</i> | 120 | 100% |

Grading Scale: A \geq 92%, A- = 90-91.9%, B+ = 87-89.9%, B = 82-86.9%, B- = 80-81.9%; C+ = 77-79.9%, C = 72-76.9%, C- = 70-71.9%; D+ = 67-69.9%, D = 62-66.9%, D- = 60-61.9%, E < 60%

For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Class attendance and participation: You are required to attend all classes. Please let me know in an email if there is an issue that will keep you from attending class. You are expected to participate in class by answering and asking questions and participating in course discussions. You will receive 1 point per class for participating (total of 2 points per week).

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>.

Instructional lecture assignments: Each instructional lecture session will consist of a data set that the instructor will lead the students through and a set of questions to be answered through the application of the given week's statistical method.

Projects: Two projects will assess your skills in ordination (project 1) and clustering (project 2) techniques.

Project 1 – Ordination: The objective of this project is to apply Principal Component Analysis (PCA) and Non-metric multidimensional scaling (NMDS) to two data sets in the programming

language R. Students will answer a set of questions related to the application and interpretation of these analyses.

Project 2 – Cluster Analyses: The objective of this project is to apply k-means and hierarchical clustering techniques and test the significance of groups/clusters recovered from these cluster analyses using the programming language R. Students will answer a set of questions related to the application and interpretation of these analyses.

Final Project: The objective of the final project is for students to ask a question of their own data, select the appropriate multivariate analysis, conduct the analysis in R, and interpret your results. Students will present the project in a paper that will hopefully be a precursor to a dissertation chapter and/or manuscript. The format of the paper will follow that of a journal article. Papers should be 5 pages (not including figures, tables, and work cited) double spaced using size 12 font. In addition to the paper, students will include annotated code and the data file used in the analysis.

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>.

Online Course Evaluation Process

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

Academic Honesty

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: “*We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.*” You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: “*On my honor, I have neither given nor received unauthorized aid in doing this assignment.*”

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the

University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: <http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code>.

Software Use:

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

Services for Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

Disability Resource Center: 0001 Reid Hall, 352-392-8565, www.dso.ufl.edu/drc/

Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu/cwc/*
 - Counseling Services
 - Groups and Workshops
 - Outreach and Consultation
 - Self-Help Library
 - Wellness Coaching
- U Matter We Care, www.umatter.ufl.edu/
- *Career Connections Center, First Floor JWRU, 392-1601, <https://career.ufl.edu/>.*
- Residential Course: <https://sccr.dso.ufl.edu/policies/student-honor-code-studentconduct-code/>.

- Online Course: <http://www.distance.ufl.edu/student-complaint-process>