



UNIVERSIDADE FEDERAL DE SANTA CATARINA
PÓS-GRADUAÇÃO EM ECOLOGIA

SYLLABUS



SEMESTER 02 / 2024

1. COURSE IDENTIFICATION

CODE	COURSE	NUMBER OF STUDENTS		WORKLOAD / SEMESTER
ECO41001	Multivariate Analysis	Min.: 4	Max.: 20	60 h (4 credits)

2. SCHEDULE

Lectures will be held in-person every Tuesday and Thursday morning (8:30–12:00 am) and afternoon (2:00–5:00 pm), from September 10th to October 3rd.

3. INSTRUCTORS

Dr. Rafael Barbizan Suhs (rbsuhs@gmail.com)

Dr. Alexandre Marcel da Silva Machado (alexandre.marcel@posgrad.ufsc.br)

4. COURSE OFFER

Graduate Program in Ecology or in related fields

5. SYLLABUS

Introduction to multivariate data analysis; Main R packages; The multivariate data, types of data used in ecological studies and correlated areas; Q-mode and R-mode; Data transformation and standardization; Distance and (dis)similarity measures, association matrices; Hierarchical Cluster Analysis and Indicator Species Analysis; Unconstrained ordination; Constrained Ordination; Testing hypotheses with multivariate data (PERMANOVA, GLMmv).

6. GOALS

To train MSc and PhD students in multivariate data analysis. Students that complete this course are expected to be able to apply Multivariate Data Analysis in their projects.

7. COURSE OUTLINE

- The structure of multivariate data;
- Data standardization and transformation;
- Distance-based matrices and association measures in Q and R mode;
- Hierarchical Cluster Analysis, Indicator Species Analysis (IndVal);
- Principal Component Analysis (PCA), Correspondence Analysis (CA and DCA), distance-based redundancy analysis;
- Principal Coordinate Analysis (PCoA) and non-metric Multidimensional Scaling (nMDS);
- Canonical ordination, Redundancy Analysis, Canonical Correspondence Analysis;
- Testing hypothesis with multivariate data;
- Linear Models (LMmv) and Generalized Linear Models (GLMmv) for multivariate abundance data;

8. DESCRIPTION OF METHODS

Lectures will encompass theoretical aspects of multivariate statistics and will be followed by practical exercises to be conducted using the R programming language. Additional readings will be suggested to cover the key topics of the theoretical background on statistics. The students will have the opportunity to discuss the challenges and solutions of multivariate data analyses based on their experiences.

9. COURSE GRADING

In order to be approved, as in Art. 50 number 95/CUn/2017, a student must attend to at least 75% of the classes and obtain a minimum grade of 7.0, based on the formula: $\frac{\text{(average of assignments and quizzes + final report)}}{2}$

10. CLASS SCHEDULE

Tuesday and Thursday morning (8:30–12:00 am) and afternoon (2:00-5:00 pm)

When? *	What?
September 10 th	Introduction, the structure of multivariate data, data standardization and transformation
September 12 th	Matrices and association measures in Q and R mode
September 17 th	Hierarchical Cluster Analysis, Indicator Species Analysis (IndVal)
September 19 th	Introduction to ordination methods, Principal Component Analysis (PCA), Correspondence Analysis (CA and DCA), distance-based redundancy analysis
September 24 th	Principal Coordinate Analysis (PCoA) and non-metric Multidimensional Scaling (nMDS)
September 26 th	Canonical ordination, Redundancy Analysis (theory and practice), Canonical Correspondence Analysis
October 1 st	Testing hypothesis with multivariate data: PERMANOVA and Mantel test.
October 3 rd	Linear Models (LMmv) and Generalized Linear Models (GLMmv) for multivariate abundance data.

11. TEXTBOOK

Borcard D., Gillet F., Legendre P. (2018). 2 ed. Numerical ecology with R. Springer, London.
Legendre P., Legendre L. (2012). 3 ed. Numerical Ecology. Elsevier, Amsterdam.
Rodrigues da Silva F., Gonçalves-Souza T., Paterno G. B., Provete D. B., Vancine M. H. (2022). Análises Ecológicas no R. Nupea e Canal 6, Recife/São Paulo.
Gotelli N.J., Ellison A.M. (2011). A Primer of Ecological Statistics. Oxford University Press.

12. SOFTWARE

- R 4.0 or newer (<https://www.r-project.org/>);
- RStudio (<https://posit.co/downloads/>);