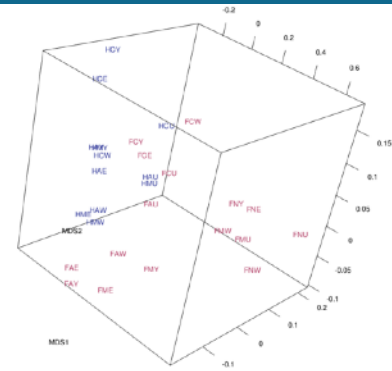


# MULTIVARIATE ANALYSES FOR MARINE ECOLOGY

Master SDUEE, Sciences de la Mer speciality  
UE MU4MRM55, 6 ECTS  
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This teaching unit focuses on statistical techniques used to analyse multivariate data and time series in oceanography or, more generally, in environmental sciences. We teach how to choose and associate appropriate statistical methods, the theoretical basis of these different methods and their practical implementation through the use of specialised software and programming, using R.

## TOPICS

In particular, the following methods will be presented:

- Distance measures relevant in ecology: Euclidean, Khi-2, Bray-Curtis, etc.
- Ordination in reduced space: PCA, CA, MDS
- Grouping methods: hierarchical grouping, k-means
- Multiple regression and classification methods: RDA, CCA, LDA, Classification Trees (RandomForest etc.)
- Multivariate time series analysis: characterisation of scales and trends, detection of cycles, detection of exceptional events, etc.

## ORGANISATION

The theoretical basis of each method is detailed during a half-day course, focusing on the conditions of application of each method, their choice and the interpretation of their results. The mathematical underpinnings are presented to enable a complete understanding of the method but without requiring an advanced level of knowledge.

Then, each method is practiced during a half-day computer lab session, allowing to apply it on one or several datasets which highlight its characteristics well. These labs are all based on free and open source software; some methods are presented with software sporting a graphical interface (Tanagra and Past), others via programming in R. Training in these programs and in R is included at the beginning of the module.

This theoretical knowledge is evaluated through a 3 hours written exam, which consists of theoretical questions as well as exercises.

Finally, the last two days are devoted to personal projects, during which students analyse a small dataset, which is either provided to them or that they brought with them. Each project is the subject of an oral presentation, which is also graded.

## PREREQUISITES

This module deals with multivariate analyses and assumes prior knowledge of classical inferential statistics (notion of variance, ANOVA, simple regression).

## REFERENCE BOOKS

Numerical ecology. Legendre, Legendre, 2012. 3rd English edition. Elsevier.  
Numerical ecology with R. Borcard, Gillet, Legendre, 2011. Springer  
An Introduction to Applied Multivariate Analysis with R. Everitt, Hothorn, 2011. Springer.  
Analyses factorielles simples et multiples. Escoffier, Pagès, 1998. Dunod.  
Statistique exploratoire multidimensionnelle. Lebart, Morineau, Piron, 1997. Dunod.

## ACQUIRED KNOWLEDGE

Programming in R  
Using of specialised statistical software  
Choosing multivariate analysis methods according to the question of interest  
Actually using multivariate analysis methods and interpreting results  
Conducting a complete analysis of a dataset

## PRACTICAL INFORMATION

This module can, in general, be accepted as a PhD class, sanctioned by an exam. At the very least, a certificate of participation can be issued.

The module is open to French and foreign students in a Master or PhD degree, assuming the prerequisites mentioned above are known. If foreign students register, the courses will be given in English.

The marine station of Villefranche offers accommodation and catering options.

Students are expected on the Saturday or Sunday preceding the start of classes. Classes begin Monday at 9 am and end on the last Friday at noon.

Registration is through the e-Candidate platform.

More information on <http://sciencesdelamer.sorbonne-universite.fr>