Advanced Course: Experimental Design and Analysis of Multivariate Data
Date: 13 – 17 January 2025
Type of course: Theoretical/Practical
Venue: University of Aveiro (UA), on-line course
Coordinator: Victor Quintino, Department of Biology and CESAM, University of Aveiro

Description
The course comprises five morning and five afternoon daily sessions and is delivered on-line. The course follows a problem-solving approach, exploiting teaching and learning case studies. The teaching case studies present the baseline theoretical concepts and the software (PRIMER v7 with the add-on PERMANOVA+). The learning case studies use real datasets and allow participants to apply the theoretical concepts and acquire autonomy in the choice and workflow of the methods. PhD students that already have their own data, should find enough time to exploit it and discuss the methods.

Syllabus
1. Introduction. From univariate to multivariate data collection and analysis.
2. Resemblance. Resemblance functions for the analysis of variables – association and correlation coefficients – and samples – similarity and distance functions. Appropriateness of the resemblance functions to the dataset. Choosing a resemblance function. Data transformation.
3. Clustering. Advantages and limitations. The panoply of methods. Agglomerative and divisive methods. Agglomerative hierarchical clustering: single, complete, average and flexible algorithms. Construction and interpretation of dendrograms.
4. Ordination. Advantages and limitations. The panoply of methods. Principle coordinate and component analysis (PCO and PCA), correspondence analysis (CA) and multi-dimensional scaling (MDS). Biplots and interpretation of factorial axes.
5. Multivariate hypothesis testing. Fixed and casual factors, orthogonal and hierarchical designs. Implications on the estimation of variance components. Hypothesis testing with multivariate data using analysis of similarities (ANOSIM) and permutation multivariate analysis of variance (PERMANOVA).

Learning outcomes
During the course, participants acquire theoretical background on multivariate data analysis and experimental design, as well as training in the use of appropriate software to run the analysis. At the end of the course, the following outcomes are expected:

1. Exploitation and analysis of multivariate data, including the selection of adequate resemblance functions and data transformation options.
2. Use clustering, ordination and hypothesis testing methods to analyse multivariate data.
3. Set-up an experimental design to answer a given question, identify the factors involved and their relationship, as well as the adequate controls.
4. Achieve the above-mentioned objectives using appropriate software.

Who can participate and course assessment
The course is primarily devoted for students attending UA doctoral programs but can accommodate other participants. Assessment is restricted to participants attending UA doctoral programs (6 ECTS advanced course). To register, e-mail Prof. Victor Quintino (victor.quintino@ua.pt), no later than January 6, 2025.