Université de Bretagne Occidentale

MASTER BIOLOGIE

PARCOURS INTERNATIONAL MASTER OF SCIENCE IN MARINE BIOLOGICAL RESOURCES (IMBRSEA)

semestre 7

Quantitative methods in marine science

Présentation

2 crédits ECTS

Volume horaire

Cours Magistral : 10h
Travaux Pratiques : 10h

Numerical tools help to ask scientific questions more efficiently and extract appropriate answers. This course will introduce students to many basic techniques in data analysis and numerical modelling, to help them summarise a problem in mathematical terms, plan experiments or field sampling campaigns, and gather insights from the data collected.

Students will learn how to identify sources of variation in biological data and decide on sampling/ experimental units and replicates. Major inferential statistical and data exploration techniques will be taught. Numerical models will be introduced as a way to simplify and formalise a system. A programming language (R) will be used to apply all those techniques.

Objectifs

Students will learn how to translate a marine sciences question or hypothesis in mathematical terms and how to select the factors that are more relevant to answer it. They should realise that this formalisation should precede and information data acquisition rather than be considered after the fact.

Pré-requis nécessaires

Bachelor in sciences. Basic knowledge in sampling and experimental design (notion of replicate), descriptive statistics (distributions, statistical moments), and basic statistical inference (comparison of means, correlation, one-way ANOVA, simple linear regression).

Compétences visées

Students will learn:

- how to use computer code to read and manipulate data, to implement statistical tests or dynamical models

- how to efficiently plan an experiment or field sampling campaign

- how to choose an appropriate data analysis technique

- how to interpret the output of basic inferential statistics

- how to represent data and model output graphically

Descriptif

The class will consist of theoretical parts and applications to actual data sets. The themes tackled are presented below. While the core of the programme will be the same in all universities, some classes are optional (in brackets: []) and the specific time spent on each part will vary between universities.

Maths and programming basics

notion of variable and of assignation; data types; data import; data manipulation, repetition of operations.

numerical integration of differential equations; matrix computation

data representation (plotting)

Experimental/sampling design

best practices in experiment and sampling design for optimal statistical power

Linear model

revision of simple linear regression, revision of ANOVA (as a particular case of linear model)

multiple regression and multi-factor ANOVA; model selection

introduction to generalised linear model: logistic regression, Poisson regression

[introduction to mixed effects models]
Non parametric tests

notion of rank, basic non-parametric version of inferential tests (Wilcoxon-Mann-Whitney, Kruskall-Wallis)

[notion of bootstrap and bootstrap tests]
Introduction to multivariate data analysis

Principal Component Analysis

[Correspondence Analysis or Multidimensional Scaling]
Numerical modelling

0D dynamical box and flux models (Fasham-like NPZD model)

Population dynamics models (Leslie-like matrix models)

Bibliographie

UPMC: Biostatistique (Scherrer), Numerical Ecology (Legendre & Legendre),

Uniovi: Sampling, 3rd Ed (S.K. Thompson),

Ugent: Experimental design and analysis for Biologists (Quinn & Keough (2002))

Modalités de contrôle des connaissances

Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit - devoir surveillé	180	4/7	
	CT	Travaux Pratiques	240	2/7	
	CC	Ecrit - devoir maison		1/7	

Session 2 : Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit et/ou Oral		100%	