Course Specifications
From the academic year 2017-2018 up to and including the
Quantitative Methods in Marine Science (C004023)

Course

Lecturers in academic year 2019-2020
Arrontes, Julio
Ardura, Alba
Garcia Vazquez, Eva

A (semester 1) English

Offered in the following programmes in 2019-2020
International Master of Science in Marine Biological Resources (main subject Applied Marine Ecology and Conservation) 6 A
International Master of Science in Marine Biological Resources (main subject Global Ocean Change) 6 A
International Master of Science in Marine Biological Resources (main subject Management of Living Marine Resources) 6 A
International Master of Science in Marine Biological Resources (main subject Marine Environment Health) 6 A
International Master of Science in Marine Biological Resources (main subject Marine Food Production) 6 A

Teaching languages
English

Keywords

Position of the course

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.

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

Contents

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)

Initial competences
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).

Final competences
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.

Conditions for credit contract
Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract
This course unit cannot be taken via an exam contract

Teaching methods
Lecture, seminar

Extra information on the teaching methods
lectures (h):
24
computer class (h):
36
other (h):
University lectures (h) field work (h) other (h) UGent 24 ... ... 32 ... ...
UAAlg ... ... ... 60 ... ... 
UPMC 24 ... ... 36 ... ...
UniOvi 24 ... ... 24 ... ...

Learning materials and price

References
UPMC: Biostatistique (Scherrer), Numerical Ecology (Legendre & Legendre),
UniOvi: Sampling, 3rd Ed (S.K. Thompson),
Ugent: Experimental design and analysis for Biologists (Quinn & Keough (2002))

Course content-related study coaching

Evaluation methods
end-of-term evaluation

Examination methods in case of periodic evaluation during the first examination period
Assignment

Examination methods in case of periodic evaluation during the second examination period
Assignment

Examination methods in case of permanent evaluation

(Approved)
Possibilities of retake in case of permanent evaluation
   not applicable
Extra information on the examination methods
   UALG: 3 h final exam, open notes with broad interpretation questions
   UPMC: 3h written exam, no documents, exercises and interpretation questions
   UGent: 3h written exam + oral feedback
   Uniovi: Assignment describing a complete sampling protocol/experimental design on a realistic scenario
Calculation of the examination mark