Course guide
250567 - METESTCIMA - Statistical Methods in Marine Sciences

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR’S DEGREE IN MARINE SCIENCE AND TECHNOLOGY (Syllabus 2018). (Compulsory subject).

Academic year: 2022 ECTS Credits: 6.0 Languages: Spanish

LECTURER

Coordinating lecturer: AGUSTÍ PÉREZ FOGUET
Others: AGUSTÍ PÉREZ FOGUET

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
13388. To know and apply the lexicon and concepts of the Marine Sciences and Technologies and other related fields.
13390. Establish a good practice in the integration of common numerical, laboratory and field techniques in the analysis of any problem related to the marine environment.
13394. Address the most relevant processes and their interactions related to their physical / chemical / biological / geological components, applying technical and scientific knowledge and criteria.
13403. Develop a conceptual framework to address the sustainability of the marine environment and the related socio-economic activities at different scales, explaining the effects of climate change.
13405. Carry out calculations, assessments, surveys and inspections in coastal and marine environments, as well as the corresponding technical documents.
13407. Apply the necessary tools to analyze the economic and legal aspects of human actions and the related impacts on the marine environment, including technical advice and representation of companies and administrations.

Generic:
13380. Develop a professional activity in the field of Marine Sciences and Technologies.
13381. Address in a comprehensive manner the analysis and preservation of the marine environment with sustainability criteria.

TEACHING METHODOLOGY

The course consists of 2 hours per week of classroom activity (large size group) and 2 hours weekly with half the students (medium size group).

The 2 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 2 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.
LEARNING OBJECTIVES OF THE SUBJECT

In this subject, statistical methods that allow explaining correlations and dependencies of natural and anthropogenic processes in the sea will be presented, emphasizing fundamental aspects of exploratory statistics such as descriptive analysis of multivariate data, bivariated distribution, extreme models, principal component analysis, regression models, grouping and classification methods and introduction to Bayesian statistics.

1.- Critically analyze a multivariate database (be it of real, positive, directional or compositional scale) using exploratory (e.g. biplot) and descriptive (e.g. PCAs) techniques.
2.- Establish multiple regression models and simple generalizations of them (e.g. ANOVA). Interpret the diagnoses about the models, as well as critically analyze their predictive uses.
3.- Classify and discriminate large capacity multivariate databases with supervised and unsupervised classification methods, for later analysis and critical interpretation.

This is where students are expected to obtain a vision of real environmental problems in the marine environment from a perspective that combines, on the one hand, chemistry and biology, as well as the mathematical techniques to address these problems (Marine Ecology, Ecosystems and Productive Processes) and, on the other, the tools of chemistry, biology and physics (Marine Pollution, Origin, Transport and Impacts), which are needed to solve common problems in coastal and platform waters.

This subject also includes applied techniques in the visualization, interpretation and resolution of the problems addressed in this same subject.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
</tr>
<tr>
<td>Self study</td>
<td>84,0</td>
<td>56.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

- **Generalized linear models**
  - **Description:** Generalized linear models
  - **Full-or-part-time:** 4h 48m
    - Theory classes: 2h
    - Self study: 2h 48m
### Linear regression

**Description:**
Simple linear regression with continuous variables and factors  
Practical programming session (R)  
Multiple linear regression  
Selection of models and data  
Practical programming session (R)  
Problems  

**Full-or-part-time:** 28h 47m  
Theory classes: 6h  
Practical classes: 3h  
Laboratory classes: 3h  
Self study : 16h 47m

### Logistic regression

**Description:**
Logistic regression.  
Problems  

**Full-or-part-time:** 9h 36m  
Theory classes: 2h  
Practical classes: 2h  
Self study : 5h 36m
<table>
<thead>
<tr>
<th>Course</th>
<th>Full-or-part-time</th>
<th>Theory classes</th>
<th>Laboratory classes</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear and logistic regression</td>
<td>4h 48m</td>
<td></td>
<td>2h</td>
<td>2h 48m</td>
</tr>
<tr>
<td>Models for count data</td>
<td>A2</td>
<td>4h</td>
<td>2h</td>
<td>8h 23m</td>
</tr>
<tr>
<td>Bayesian statistics</td>
<td>28h 47m</td>
<td>8h</td>
<td>4h</td>
<td>16h 47m</td>
</tr>
</tbody>
</table>
Bayesian statistics

Description:
Introduction to Bayesian Statistics
Conjugated distributions
Decision making
Problems

Full-or-part-time: 28h 47m
Theory classes: 8h
Practical classes: 4h
Self study: 16h 47m

Frequency analysis and extreme events

Description:
Frequency analysis and extreme events
Asymptotic distributions
Practical programming session (R)
Over-threshold distributions
Models for maximum winds and wave heights
Problems and applications
A3.

Full-or-part-time: 38h 24m
Theory classes: 8h
Practical classes: 4h
Laboratory classes: 4h
Self study: 22h 24m

Frequency analysis and extreme events

Description:
Frequency analysis and extreme events
Asymptotic distributions
Practical programming session (R)
Over-threshold distributions
Models for maximum winds and wave heights
Problems and applications
A3.

Full-or-part-time: 38h 24m
Theory classes: 8h
Practical classes: 4h
Laboratory classes: 4h
Self study: 22h 24m
**Generalized linear models and extreme value models.**

**Description:**
Problems

**Full-or-part-time:** 14h 23m
  - Practical classes: 2h
  - Laboratory classes: 4h
  - Self study: 8h 23m

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**GRADING SYSTEM**

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the weighted average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

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**EXAMINATION RULES.**

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

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**BIBLIOGRAPHY**

**Basic:**

**Complementary:**
- Castillo, E. [et al.]. Extreme value and related models with applications in engineering and science. Hoboken, New Jersey: John