
DEGREE CURRICULUM

# INTRODUCTION TO SPATIAL STATISTICS: SPATIAL ANALYSIS WITH R

Coordination: VEGA GARCIA, CRISTINA

Academic year 2023-24

# Introduction to Spatial Statistics: Spatia... 2023-24

## Subject's general information

<table>
<tr><td>Subject name</td><td>Introduction to Spatial Statistics: Spatial analysis with R</td></tr>
<tr><td>Code</td><td>111019</td></tr>
<tr><td>Semester</td><td>ANUAL CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Master's Degree Erasmus Mundus in Spatial and Ecological Modelling in European Forestry</td><td>1</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>5</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><td>PRAULA</td><td>TEORIA</td></tr>
<tr><th>Number of credits</th><td>3.5</td><td>1.5</td></tr>
<tr><th>Number of groups</th><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>VEGA GARCIA, CRISTINA</td></tr>
<tr><td>Department</td><td>AGRICULTURAL AND FOREST SCIENCES AND ENGINEERING</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>5 hours of lectures; 35 hours of independent student work; 10 hours of problem solving.</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>English</td></tr>
<tr><td>Distribution of credits</td><td>Theory and concepts: 1.5 ECTS<br>Practicum and problem solving: 3.5 ECTS</td></tr>
</table>

# Introduction to Spatial Statistics: Spatia... 2023-24

| Teaching staff | E-mail addresses | Credits taught by teacher | Office and hour of attention |
|---|---|---|---|
| RODRIGUES MIMBRERO, MARCOS | r.marcos.1980@gmail.com | 4,8 | |
| VEGA GARCIA, CRISTINA | cristina.vega@udl.cat | ,2 | |

## Subject's extra information

Course recommended for Track:

- Decision support systems for resource management
- Resource management for ecosystem services X
- Spatial and Ecological Modelling X
- Resource economics and policy

**Previous knowledge required:** Basics on GIS and remote sensing.

**Goals:**

In this course we will gradually explore the capabilities of R as a spatial modeling tool. From the most essential concepts of R usage to the creation of functions and geoprocessing scripts, the course will cover the most widespread tools in environmental and spatial modeling. The objective of the course is therefore to provide the student with the necessary knowledge to manipulate spatial information and implement spatial techniques from GIS and data with special focus their application to forestry and environment management.

**Learning Outcomes:**

Students are provided with a range of applied statistical tools and modelling frameworks that can be used in professional life for the analysis of spatial data. On completion of this class, students should be able to:

- Implement and use the basic tools and functions available in R.
- Select the appropriate techniques, in terms of functions and methods of a programming language, to create statistical analysis flows.
- Create specific-written functions.
- Understand, modify and/or adapt existing scripts to their own needs
- Implement and validate the main interpolation and spatial regression methods.
- Interact with spatial data, both as a source of information and as a result of the analysis process.
- Perform spatial operations on raster data.

**Contents:**

This course is intended as a first introduction to spatial modelling using free statistical software (R). The course is organized in 6 modules as follows:

Module 1: Introduction to R :

- Procurement and installation.
- Start with R.
- Basic functions.
- Creating charts and plots.

Module 2: Spatial regression:

- Introduction to regression analysis. Climate data regression.
- Generalized Linear Models (GLM).
- Validation of models and results.

Module 3: Operations on spatial data:

- Spatial analysis packages.
- Retrieving information from GIS layers.
- Spatial regression analysis.
- Mapping with R.

Module 4: Advanced regression models:

- Control structures in R. Loops and conditional sentences.
- Regression with Random Forest. Forest fire occurrence modeling.
- Classification with Random Forest. Land cover/vegetation mapping.
- An example of species distribution modeling.

Module 5: Interpolation and spatial statistics:

- Nearest neighbor and resample.
- Spatial autocorrelation measures.
- Inverse of distance weighting.
- Kriging and semi-variograms.
- Climate data interpolation.

Module 6: Map algebra. Working with raster layers:

- Local operations.
- Filtering maps.
- Zonal operations.

**Learning Activities (Methods and Planning):**

The teaching/learning methodology is based on an eminently practical model based on problem solving with work on computer, so that the student is able to gradually assimilate theoretical content on a real application environment.

The contents to be developed within each of the modules will be introduced through brief theoretical presentations in which the essential concepts will be exposed; allowing the proper performance of the corresponding practical sessions.

Tutored exercises will be developed guiding the student using short introductory theoretical sessions. Likewise, the completion of each of the modules will involve the completion of a synthesis exercise that allows, on the one hand, to assimilate in a global way the contents taught in the module and, on the other hand, to assess the achievement of the objectives of the course.

**Evaluation System:**

The evaluation of the course will be derived from the following activities:

- 75% of the grade: delivery by the student of a portfolio which integrates the practical exercises proposed on each module of the course. This will allow assessing the competency level achieved in practical terms.
- 25% of the qualification: the student performs a short test evaluating their mastery on essential and specific concepts.

**Bibliography:**

Dalgaard, P. (2008). Introductory Statistics with R (Statistics and Computing). Springer; 2nd Edition. 384 pp.

Bivand, R.S.; Pebesma E; Gómez-Rubio, V. (2013). Applied Spatial Data Analysis with R (Use R!). Springer; 2nd Edition. 424 pp.

Brundson C. and Comber, L. (2015). An Introduction to R for Spatial Analysis and Mapping. SAGE Publications Ltd. 360 pp.

## Learning objectives

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## Competences

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## Methodology

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## Development plan

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