200633 - EE - Spatial Epidemiology

Coordinating unit: 200 - FME - School of Mathematics and Statistics
Teaching unit: 1004 - UB - (ENG)Universitat de Barcelona
Academic year: 2019
Degree: MASTER'S DEGREE IN STATISTICS AND OPERATIONS RESEARCH (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: English

Teaching staff
Coordinator: JOSEP LLUÍS CARRASCO JORDAN
Others: Primer quadrimestre:
   ROSA Mª ABELLANA SANGRÀ - A
   JOSEP LLUÍS CARRASCO JORDAN - A

Degree competences to which the subject contributes

Specific:
4. CE-1. Ability to design and manage the collection of information and coding, handling, storing and processing it.
5. CE-2. Ability to master the proper terminology in a field that is necessary to apply statistical or operations research models and methods to solve real problems.
6. CE-5. Ability to formulate and solve real problems of decision-making in different application areas being able to choose the statistical method and the optimization algorithm more suitable in every occasion.
7. CE-6. Ability to use appropriate software to perform the necessary calculations in solving a problem.
8. CE-7. Ability to understand statistical and operations research papers of an advanced level. Know the research procedures for both the production of new knowledge and its transmission.
9. CE-8. Ability to discuss the validity, scope and relevance of these solutions and be able to present and defend their conclusions.
10. CE-9. Ability to implement statistical and operations research algorithms.

Transversal:
1. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
2. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
3. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Teaching methodology
The main concepts of each topic will be treated in the classroom by in-person lessons which will be illustrated by real data examples. Furthermore, supplementary stuff will be available for students to complement the concepts treated in the classroom.
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Learning objectives of the subject

When the student finishes the course, he or she should be able to:
- Identify the spatial structure type of a data set.
- Use the tools for exploratory spatial data analysis.
- Interpolate geostatistical data.
- Adjust models for lattice data with spatial correlation.
- Identify the pattern of spatial structure in point data.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group:</th>
<th>30h</th>
<th>24.00%</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>15h</td>
<td>12.00%</td>
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<td></td>
<td>Guided activities:</td>
<td>0h</td>
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<td></td>
<td>Self study:</td>
<td>80h</td>
<td>64.00%</td>
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</table>
# Content

## 1. GEOSTATISTICS

<table>
<thead>
<tr>
<th>Description:</th>
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</table>
| 1.1. Introduction. Various Examples.  
1.2. Exploratory Analysis for Geostatistical Data.  
1.3. Variograms: Modelization and Estimates.  
1.4. Spatial Prediction and Kriging. |

<table>
<thead>
<tr>
<th>Learning time: 40h</th>
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</table>
| Theory classes: 5h  
Practical classes: 2h 30m  
Laboratory classes: 2h 30m  
Tutorials: 1h 15m  
Assessment sessions: 1h 15m  
Self study (distance learning): 27h 30m |

## 2. LATTICE DATA

<table>
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<tr>
<th>Description:</th>
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| 2.1. Introduction. Examples.  
2.2. Definitions of the proximity matrix  
2.3. Exploratory Data Analysis: definitions of the proximity matrix, measurements of spatial association  
2.4. Autoregressive models and heterogeneity spatial models. Definition, specifications and Properties  

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<thead>
<tr>
<th>Learning time: 40h</th>
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</thead>
</table>
| Theory classes: 5h  
Practical classes: 2h 30m  
Laboratory classes: 2h 30m  
Tutorials: 1h 15m  
Assessment sessions: 1h 15m  
Self study (distance learning): 27h 30m |

## 3. SPATIAL POINT PROCESSES

<table>
<thead>
<tr>
<th>Description:</th>
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</table>
| 3.1. Introduction. Various Examples.  
3.2. Basic Theory of Point Processes  
3.3. Exploratory Data Analysis (EDA) for Point Processes  
3.4. Models of Point Processes |

<table>
<thead>
<tr>
<th>Learning time: 40h</th>
</tr>
</thead>
</table>
| Theory classes: 5h  
Practical classes: 2h 30m  
Laboratory classes: 2h 30m  
Tutorials: 1h 15m  
Assessment sessions: 1h 15m  
Self study (distance learning): 27h 30m |
Students must solve some exercises at the end of each of the three blocks that make up the subject. These exercises must be delivered within a certain period to be announced during the course. The three exercises will be scored between 0 and 10, and the average of these three qualifications will be the exercise mark (NEJ).

Additionally, a test will be programmed with multiple choice questions at the end of the course that will include the complete syllabus of the subject. The qualification of this test (NPE) will be between 0 and 10. The attendance to this test will be optional and will be aimed at those students who wish to improve their qualification based on the NEJ.

The final grade of the subject will be calculated as:

1) For those students who do not attend the final test, the final grade of the subject will be the NEJ.
2) For those students who take the final test, the final grade of the subject will be the average of NPE and NEJ.

The subject is considered approved if the final grade is higher than 5.

Bibliography

Basic:

- Gelfand, Alan; Diggle, Peter; Fuentes, Montserrat; Guttorp, Peter. Handbook of spatial statistics. CRC Press, 2010.

Others resources:

**Computer material**

**R**

R is a free software environment for statistical computing and graphics.

http://www.r-project.org/

**WinBUGS**

WinBUGS is part of the BUGS project, which aims to make practical MCMC methods available to applied statisticians.

http://www.mrc-bsu.cam.ac.uk/bugs/winbugs/contents.shtml