200633 - EE - Spatial Epidemiology

Coordinating unit: 200 - FME - School of Mathematics and Statistics
Teaching unit: 1004 - UB - (ENG) Universitat de Barcelona
Academic year: 2017
Degree: MASTER'S DEGREE IN STATISTICS AND OPERATIONS RESEARCH (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: Spanish, 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.
   Translate to english
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.
At the end of each subject block, students should solve a problem in the classroom using the R and WinBugs software.
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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>
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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>
<td>0.00%</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>80h</td>
<td>64.00%</td>
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## Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Learning time: 40h</th>
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</thead>
</table>
| **1. GEOSTATISTICS** | 1.1. Introduction. Various Examples.  
1.2. Exploratory Analysis for Geostatistical Data.  
1.3. Variograms: Modelization and Estimates.  
1.4. Spatial Prediction and Kriging. | 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** | 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  
2.7. Bayesian Estimation, Gibbs Sampling Algorithm. Convergence diagnostic. | 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** | 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 | Theory classes: 5h  
Practical classes: 2h 30m  
Laboratory classes: 2h 30m  
Tutorials: 1h 15m  
Assessment sessions: 1h 15m  
Self study (distance learning): 27h 30m |
Qualification system

At the end of any of the three subject blocks the students should solve a problem in the classroom that must be delivered within a certain period. The three exercises will be marked between 0 and 10 and the mean of these three marks will be the overall exercises mark (NEJ).

Moreover at the end of each subject block a test will be made with short questions (no less than 3, no more than 5). Tests will be marked between 0 and 10, and the mean of the three tests will be the overall test mark (NPE).

The final mark of the subject will be obtained as:

1) If any of the two marks NEJ or NPE are below 5, the final mark will be the minimum of NEJ and NPE.
2) If the two marks NEJ and NPE are greater (or equal) 5, the final mark will be the mean of NEJ and NPE.

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