ENV-444

Exploratory data analysis in environmental health

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Cursus	Sem.	Type
Environmental Sciences and Engineering	MA1, MA3	Opt.
Minor in Engineering for sustainability	H	Opt.
Minor in statistics	H	Opt.
Statistics	MA1, MA3	Opt.
Systèmes urbains	MA1, MA3	Opt.
Territories in transformation and climate minor	H	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Project	2 weekly
Number of positions	

Summary

This course teaches how to apply exploratory spatial data analysis to health information. Teaching focuses on the role of GIS and spatial statistics in spatial epidemiology. It proposes a context to investigate the relationship between health, quality of life, and environmental characteristics.

Content

This course consists of a theoretical and of a practical part. Each week 45 minutes of ex-catedra teaching are used to present the history of the discipline (exploratory spatial data analysis and spatial epidemiology), the theoretical background and the main software used.
The theory is followed by 1h30 of practical work during which the notions covered by the theory are implemented in the computer lab. The data used are provided by current research case studies related to environmental health (e.g. sleep troubles and road traffic noise). Data exploration, geovisualization, geocomputation, communication (semiology of graphics) and representation (thematic mapping) are implemented in the context of exercises. In parallel, the data provided and the approaches taught have to be used to write scientific papers (1 short and 1 regular).

Keywords

Exploratory spatial data analysis; epidemiology; environmental health; spatial epidemiology; Exposome; Geocomputation; EDA; ESDA;
Geovisualization; GIS; Geoda; Thematic mapping; Semiology of graphics; Spatial statistics; Scientific paper writing

Learning Prerequisites

Required courses

It is **compulsory** that students have attended the course "Systèmes d'Information Géographique" (ENV-342). The notions taught during this course require a good knowledge of Geographic Information Systems and of GIScience basic concepts, as well as a perfect understanding of the english language.

Recommended courses

- Systèmes d'Information Géographique (SIG), ENV-342, bachelor, 2ème année
- MOOCs Systèmes d'Information Géographique 1 et 2, sur Courseware

Important concepts to start the course

Statistics; Spatial statistics; Geographic Information Systems; Epidemiology; Exposome; Environmental health

Learning Outcomes

By the end of the course, the student must be able to:

- Investigate the variation of attributes according to the change of the location of a set of spatial units
- Elaborate a research project based on the characteristics of a georeferenced data set available
- Formulate hypotheses to be validated in the context of a research project
- Report on the main results obtained in the context of a research project
- Interpret the main results obtained based on the spatial distribution of the objects under investigation
- Structure ideas and arguments in the context of the writing of short scientific papers
- Produce adequate geospatial data sets for the processing of spatial statistics and association models
- Investigate the variation of attributes according to the change of the location of a set of spatial units
- Elaborate a research project based on the characteristics of a georeferenced data set available
- Formulate hypotheses to be validated in the context of a research project
- Report on the main results obtained in the context of a research project
- Interpret the main results obtained based on the spatial distribution of the objects under investigation
- Structure ideas and arguments in the context of the writing of short scientific papers
- Produce adequate geospatial data sets for the processing of spatial statistics and association models

Transversal skills

- Set objectives and design an action plan to reach those objectives.
- Use a work methodology appropriate to the task.
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.
- Take feedback (critique) and respond in an appropriate manner.
- Write a scientific or technical report.
- Summarize an article or a technical report.
- Negotiate effectively within the group.
- Make an oral presentation.

Teaching methods

- Ex-cathedra teaching
- Exercises (practicals in geolab)
- Collaborative work within groups
- Writing of short scientific articles
- Videos

Expected student activities

Attend and participate in theoretical courses, apply the instructions proposed during the practicals, write short articles, present a project orally, show initiative

Assessment methods

Continuous control during the semester:

- Excercises (individual) = 20%
- Writing a scientific article (group) = 40%
- Oral presentation of the research carried out (collective presentation with individual evaluation) = 40%

Supervision

Office hours	Yes
Assistant.e.s	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

- Anselin L, McCann M (2009) OpenGeoDa, Open Source Software for the Exploration and Visualization of Geospatial Data. In: Proceedings of the 17th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems, pp. 550-551. ACM, New York, NY, USA.
- Cui Yuxia, Balshaw David M., Kwok Richard K., Thompson Claudia L., Collman Gwen W., & Birnbaum Linda S. (2016). The Exposome: Embracing the Complexity for Discovery in Environmental Health. Environmental Health Perspectives, 124(8), A137-A140. doi: 10.1289/EHP412
- Harris TM (2017) Exploratory Spatial Data Analysis: Tight Coupling Data and Space, Spatial Data Mining, and Hypothesis Generation. In: Regional Research Frontiers - Vol. 2, pp. 181-191. Springer, Cham.
- Morgenthaler, Stephan (2009) Exploratory data analysis. Wiley Interdisciplinary Reviews: Computational Statistics, 1, 33-44
- Siroux, V., Agier, L., & Slama, R. (2016). The exposome concept: a challenge and a potential driver for environmental health research. European Respiratory Review, 25(140), 124-129. doi:10.1183/16000617.0034-2016
- Tukey JW (1980) We Need Both Exploratory and Confirmatory. The American Statistician, 34, 23-25.

Ressources en bibliothèque

- We Need Both Exploratory and Confirmatory / Tukey
- Exploratory data analysis / Morgenthaler
- Exposome: Embracing the Complexity for Discovery in Environmental Health / Cui et al.
- OpenGeoDa, Open Source Software for the Exploration and Visualization of Geospatial Data / Anselin, McCann
- Exploratory Spatial Data Analysis: Tight Coupling Data and Space, Spatial Data Mining, and Hypothesis Generation / Harris
- The exposome concept: a challenge and a potential driver for environmental health research / Siroux

Notes/Handbook

Lecture notes will be gradually distributed to students during the semester.

Websites

- https://geodacenter.github.io/

Moodle Link

- https://go.epfl.ch/ENV-444