Spatial Statistics
PhD School in Statistical Sciences, University of Padua

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Course Description

This course aims to introduce students to statistical models for spatial data. The course will deal with methods for two main topics of spatial statistics: (i) data referenced in points, (ii) areal / lattice data. Students will also be introduced to the computational aspects of spatial statistics through the main packages in R for the analysis of spatial data. Examples of real data come mainly from environmental sciences.

Program

1. Introduction to spatial statistics:
   (a) point level data
   (b) network data
   (c) spatial point processes
2. Models for point level data:
   (a) random fields
   (b) parametric models for the spatial correlations
   (c) variogram
3. Prediction and simulation
4. Inference for point level data:
   (a) moment estimator
   (b) maximum likelihood estimator
   (c) estimation methods for large dataset
5. Second order spatial models for network data:
   (a) spatial autocorrelation
   (b) spatial autoregressive models
6. Gaussian-Markov random fields on networks.
7. Hierarchical spatial models and Bayesian statistics:
   (a) spatial regression and Bayesian kriging
   (b) hierarchical spatial generalized linear models

Recommended texts

- Banerjee, S., Carlin, B.P. and Gelfand. A.E (2014) *Hierarchical Modeling and Analysis for Spatial Data*, CRC Press, New York (second edition)
- Gaetan, C. and Guyon, X. (2010) *Spatial Statistics and Modeling,* Springer, New York.
- Gelfand, A.E., Diggle, P., Guttorp, P. and Fuentes, M. (2010) *Handbook of Spatial Statistics*, CRC Press, New York

Grading

There will be two assignments, a project on real data and a final written exam. The assignments will account for 20% of the final grade, the project 30% and the written exam will account for 50%.

Final exam

The written exam (two hours) will present theoretical questions. It is a closed-book, closed-notes exam. Questions demand that students approach the solution with conceptual understanding of the problem.