Spatial Statistics

PhD School in Statistical Sciences, University of Padua

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Course Description

This course is designed to introduce the students to statistical models for spatial data. The course will cover methods for two major topics of spatial statistics : (i) point-referenced data, (ii) areal/lattice data. Students will also be introduced to the computational aspects of spatial statistics, illustrating the main packages in R for the analysis of spatial data. The real data examples mainly come 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 interpolation (Kriging):

    (a) Lagrange multiplier approach

    (b) Conditional inference approach

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 homeworks, an oral presentation, a project on real data and a final written exam. The homeworks will count 20%. The project will count 20%. The oral presentation and the final exam will account for the bulk of the mark (20

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.