Course name:

Introduction to statistical methods for spatial data analysis

Requirements:

Hand in all the labs and exercises

Schedule

Week 1-5: Introduction

1. Spatial and temporal data, predictive modelling, statistical thinking, nearest neighbour

2. Regression in spatial data: spatial dependency.

Area and point-referenced data, geostatistics (details in variograms), spatial econometric models (details in spatial lag models).

3. Regression in spatial data: spatial heterogeneity.

Geographically weighted regression (details in kernel functions). Introduction to classification and change detection.

4. Special considerations in spatial modelling (stresses on the problem of change of support).

5. Big data: data model vs. algorithmic model. Machine learning: supervised, unsupervised, reinforcement learning.

Lab: introduction to Python (covers data structure, class, functions, control flow, numpy and matplotlib)

deadline: Nov. 26

Week 6: Spatial data exploratory analysis

Lab: spatial data exploratory analysis

deadline: Dec. 9

Week 7: Guest lecture, MAUP (modifiable unit problems) in spatial analysis (01-12)

Week 8-9: Linear methods in regression (08-12, 15-12)

Linear regression, assumptions, significance levels, coefficient estimation.

Variance and bias trade-off, penalization, Introduction to Lasso and Ridge regression

Lab: linear regression

deadline: Jan. 13

week 10 (last class before Christmas, 22-12): Proposal presentation

Week 11: Cross-Validation (12-01). CV in the presence of spatial correlation.

Lab: cross validation

deadline: Jan. 20

Week 12: Guest lecture 2: “beyond the classical kriging and least square fitting 1”

(19-01)

Spatial and Spatio temporal modelling with INLA

Week 13: Guest lecture 3: “beyond the classical kriging and least square fitting 2”

(26-01)

A semiparametric model with an asymmetry in the random errors in the spatial context.
- Smoothing Thin Plate Spline under Skew Normal settings using Laplace Approximation and Automatic differentiation.

Week 14. Final project presentation

Final project deadline: Feb. 21

Week 15: Tree-based regression and classification

Lab: Tree-based regression and classification

deadline: Jan. 04

Week 16: Ensemble learning: bagging and boosting

Lab: Ensemble learning

deadline: Feb. 03

If we move faster than the schedule, we will look into the following topics:

- Introduction to classification

- Frontiers in spatial data analysis: Deep learning in Computer Vision
- Dimension reduction: entropy, principal component analysis