WORKSHOP ON SPATIO TEMPORAL MODELLING
PROGRAMME
PAMPLONA, JUNE 25, 26 and 27, 2024.

Venue: Public University of Navarra, Aulario building, room A - 316 third floor

June 25, Tuesday	
9:15	*Welcome and opening session*
9:30-11:30	**Course on Geostatistics:** An introduction to Bayesian spatial regression
Coffee Break	
12:00-14:00	Course on Geostatistics
Lunch time	
15:30-17:30	Course on Geostatistics
Break	
18:00-19:00	**Student Presentations.** Session 1

June 26, Wednesday	
9:30-11:30	Course on Geostatistics
Coffee Break	
12:00-14:00	Course on Geostatistics
Lunch time	
15:30-17:30	Course on Geostatistics
Break	
18:00-19:00	**Student Presentations.** Session 2

June 27, Thursday	
9:00-12:00	Course on Geostatistics
Coffee Break	
12:30-14:00	**Seminar on Point Processes:** Statistical models for the analysis, prediction and monitoring of space-time data. Applications to infectious diseases and crime
Lunch time	
15:30-18:30	**Workshop on Areal Data**: Bayesian scalable models to analyze high-dimensional areal data using the `bigDM` library
18:30	*Closing session*

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PROGRAMME DETAILS

COURSE ON GEOSTATISTICS

Title: An introduction to Bayesian spatial regression

Lecturer: Alexandra M. Schmidt, Professor of Biostatistics, Department of Epidemiology, Biostatistics and Occupational Health, McGill University.
E-mail: alexandra.schmidt@mcgill.ca
Web page: http://alex-schmidt.research.mcgill.ca/

Brief Course Description: This course aims at giving an introduction to spatial modelling of point referenced data under the Bayesian paradigm. Topics that will be discussed include an introduction to Bayesian inference; Gaussian processes; Stationarity and Isotropy; Geometric anisotropy; Variogram; Correlation Functions; Bayesian kriging; Bayesian kriging in non-normal models. The last part of the course will point out some current topics of research in the area, including large spatial data and spatio-temporal models. All the theory presented will be followed by examples with real data analysis using packages (e.g., Nimble and Stan) in R.

Outline of the lectures

June 25

Introduction to Bayesian inference: Bayes' theorem; conjugate families: Bayes estimators; linear models with conjugate priors; Markov chain Monte Carlo Methods: Gibbs sampler and Metropolis-Hastings algorithms; Hamiltonian Monte Carlo; Nimble and Stan.

June 26

Introduction to Geostatistics: Gaussian processes; stationarity and isotropy; geometric anisotropic; Variogram; Correlation functions; Bayesian kriging; Bayesian kriging in non-normal models. Examples using Nimble and Stan.

June 27

Multivariate spatial models: the linear model of coregionalization; spatial models for multivariate counts. Spatio-temporal models using multivariate dynamic linear models. Relaxing the assumption of normality: spatio-temporal models for skewed processes; dynamic non-Gaussian modelling of spatial processes.

Reference material

All course material (slides and R codes) used during the lectures will be made available to attendees. The slides are based on the following references:

• Banerjee, S., Carlin, B. P. and Gelfand, A. E. (2004) Hierarchical modeling and analysis for spatial data CRC Press/Chapman Hall.
• Bivand, R. S., Pebesma, E. and Gómez-Rubio, V. (2013) Applied Spatial Data Analysis with R. Springer, New York, USA.
• Diggle, P.J. and Ribeiro Jr., P.J. (2007) Model-based Geostatistics (Springer Series in Statistics).
• Wikle, C. K., Zammit-Mangion, A., Cressies, N. (2019) Spatio-Temporal Statistics with R. Chapman & Hall/CRC. Free download from here.

PROGRAMME DETAILS

WORKSHOP ON AREAL DATA

Title: Bayesian scalable models to analyze high-dimensional areal data using the `bigDM` library
Lecturer: Aritz Adin, Public University of Navarre, Pamplona (Spain)
https://github.com/aritz-adin

Abstact: Several statistical models and computational methods have emerged in the disease mapping literature, aiming to derive smoothed risk (or rates) estimates for areal data by integrating spatial and/or spatio-temporal dependence structures. However, the development of scalable models for the analysis of high-dimensional count data remains limited. The R package bigDM addresses this gap by implementing a range of univariate and multivariate scalable Bayesian models, using a "divide-and-conquer" approach. It relies on the well-known INLA (integrated nested Laplace approximation) technique for approximate Bayesian inference in latent Gaussian models.

SEMINAR ON POINT PROCESSES

Title: Statistical models for the analysis, prediction and monitoring of space-time data. Applications to infectious diseases and crime
Lecturer: Jorge Mateu, University Jaume I of Castellon, Castellon (Spain)
https://www3.uji.es/~mateu/

Abstact: The talk introduces statistical approaches for understanding the temporal and spatial dynamics of infectious diseases, particularly focusing on Covid-19. It details a non-stationary spatio-temporal point process, using a neural network-based kernel to capture spatial triggering effects. Exogenous influences from city landmarks are considered, and mechanistic models provide data-driven forms for spatio-temporal intensity functions. Cluster models for identifying unknown parents are proposed, and a method to evaluate spread direction and velocities is presented using a growth differential equation.

Crime science analyzes diverse crime data, using statistical models to detect crime generators, identify factors attracting/inhibiting crimes in a spatio-temporal region. Methods address data dimensionality, employing AI. Two key probabilistic models involve log-Gaussian Cox processes for forecasting crime risk in city subregions and stochastic models with differential equations governing crime spread.

PROGRAMME DETAILS

STUDENT PRESENTATIONS

Session1. June 25, Tuesday 18:00-19:00

Title: Non-separable first and second-order characteristics for log-Gaussian Cox processes.
Authors: **Medialdea A**, Angulo JM, Mateu J, Adelfio G.

Title: A comparative analysis of spatial smoothing in CAR-type priors
Authors: **Retegui G**, Etxeberria J, Gelfand A, Ugarte MD.

Title: A comparison between different approaches to combine diverse information sources
Authors: **Figueira M**, Conesa D, López-Quílez A, Paradinas I.

Session2. June 26, Wednesday 18:00-19:00

Title: Anomaly-based standardization of Satellite Images.
Authors: **Goyena H**, Pérez-Goya U, Militino AF, Ugarte MD.

Title: Bifurcation analysis of dengue transmission models with explicit vector dynamics.
Authors: **Kumar Srivastav A**, Aguiar M, Sttolenwerk N, Kooi B.

Title: Estimating the impact of the first year of COVID-19 vaccination in the Basque Country, Spain by constructing a counterfactual scenario: a mathematical modeling study.
Authors: **Estadilla CDS**, Mar J, Ibarrondo O, Stollenwerk N, Aguiar M.

Title: Improving coverage rates for fixed effects estimates combining spatial+ and restricted regression.
Authors: **Urdangarin A**, Goicoa T, Ugarte MD.