STATISTICAL WORKSHOP

SPATIAL AND SPATIO-TEMPORAL MODELS WITH R-INLA

Before the workshop

- Install R: https://cran.r-project.org/mirrors.html
- Install the INLA package using

```
install.packages("INLA", repos=c(getOption("repos"),
INLA="https://inla.r-inla-download.org/R/testing"), dep=TRUE)
```

- Install the R packages with the following command in the R prompt

```
install.packages(c('sp', 'splancs', 'fields', 'maps', 'maptools', 'rgdal', 'rgeos',
'inlabru'))
```

Schedule	Instructors	Plan
Day 1		
10:00 – 11:15	Laurie L. Baker	Review of background concepts
11.15 – 11.30	----------	Coffee Break
11:30 – 12:30	Elias T. Krainski	Introduction to linear models: using tools in INLA
12.30 – 14.00	----------	Lunch Break/Institute Seminar
14:00 – 15:15	Elias T. Krainski	How to fit GLMs with random effects in INLA
15:15 – 15:30	----------	Coffee Break
15:30 – 17:00	Elias T. Krainski	How to read the results and interpret them
Day 2		
10:00 – 11:15	Elias T. Krainski	Structured random effect models: Gaussian Markov random fields What INLA does: Approximations, Integration, Precision matrices, etc
11:15 – 11:30	----------	Coffee Break
11:30 – 12:30	Elias T. Krainski	Practical example How to interpret results and plot outputs
12:30-13:30	----------	Lunch Break
13:30 – 15:15	Participants	Introduction to dataset/problem Data exploration
15:15 – 15:30	----------	Coffee Break
15:30 – 17:00	Practical	Trying real datasets Fitting temporal and spatial models
Day 3		
10:00 – 11:00	Elias T. Krainski	Space-time models INLA features, Priors
11:00 – 11:30	----------	**LGBTQ+ STEM Coffee in the Museum**
11:30 – 12:30	Elias T. Krainski	Expert options in INLA
13:30 – 15:15	Participants	Case studies
15:15 – 15:30	----------	Coffee Break
15:30 – 17:00	Practical	Fitting models to real datasets
18:00 – Late		Institute Pub Social

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Preparing your data for analysis as a spatiotemporal point process:

There will be several opportunities during the course to work with your own data set. We will have time to walk through all of these steps, but if anyone wishes to get a head start, you can set up your data to be analysed using either a spatial or a spatiotemporal model the data frame will be structured as follows:

X	Y	Response	Time	Covariate1	Covariate2…
32052.64	6004.118	1	1	10	0.1
32189.59	6079.091	1	1	2	0.7
32106.67	6053.253	1	2	8	0.2

Each row is an observation at a point in space and time. X and Y are the coordinates in UTM, the Response is the value at those points (e.g. 1 rabies case, 3 birds in a nest), and Time is the time step the response was observed (e.g. month).

If you are doing a **temporal analysis** you will have the columns **(Response, Time, Covariates)**
If you are doing a **spatial analysis** you will have the columns **(X, Y, Response, Covariates)**
If you are doing a **spatiotemporal analysis** you will have the columns **(X, Y, Response, Time, Covariates)**

Spatial Domain

If you are doing a spatial or spatiotemporal analysis you will also need to define your spatial domain of interest, i.e. where data was collected and where you'd like to make your predictions. Spatial domains can be specified as a spatial polygon. Administrative areas can be downloaded from the GADM website: https://gadm.org/data.html.

Preparing data on spatial covariates:

Covariate data needs to be provided for each observation (though NAs are permitted). To make predictions from the model, covariate data will need to be defined for the whole domain of interest. Because INLA uses meshes, we need to define the covariate at each mesh node. We will go into more details during the course on how to match covariate data to mesh nodes, but if you have your covariate data available as fine rasters that is an easy form to match the mesh to.

Instructors

Elias T. Krainski did his PhD in space-time statistics at NTNU in Trondheim, Norway with Professor Håvard Rue. He taught at UFPR in Curitiba, Brazil. His work is on building practical computationally efficient space-time models. http://www.leg.ufpr.br/~elias/

Laurie L. Baker did her PhD in epidemiology at the University of Glasgow studying effective vaccination designs for fox rabies elimination, where she used INLA to conduct spatiotemporal analyses on fox rabies data. As a non-statistician she has asked and continues to ask many of the basic questions about INLA and spatiotemporal models.