TMA4250 Spatial Statistics, spring 2017

What: Tools to think about and handle spatial phenomenon.

Who :

Why :

Course page:
`https://wiki.math.ntnu.no/tma4250/2017v/start`

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- Students ...
- Lecturer: Ingelin Steinsland
- Teaching Assistent: Thea Roksvåg
- Guests: Torstein Mæland Fjeldstad and Haakon Bakka

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How: Assignments, text book(s) and lectures

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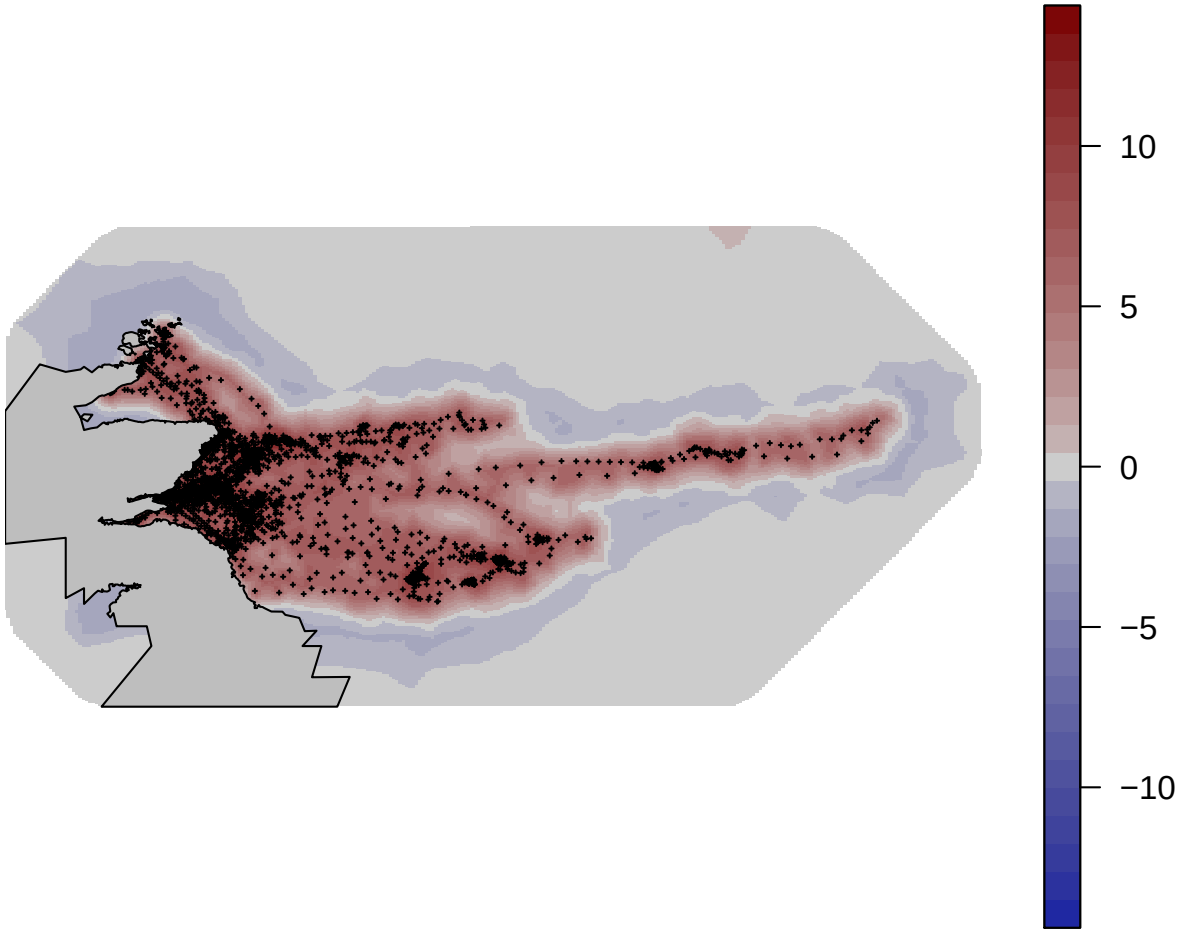
Examples of spatial staistics

- Our data
- Thea (Precipitation)
- Torstein (Lithology)
- Haakon (Seals in Scotland)
- Avalanches in Sogn
- Lightning strikes over Norway
- Methylation
- Doctor-prescription in France
- Scots pine in Sweden

Grey Seals

Presented by Haakon Bakka



Avalanges crossing roads in Sogn

From Jostein Ballestad's Master Thesis:

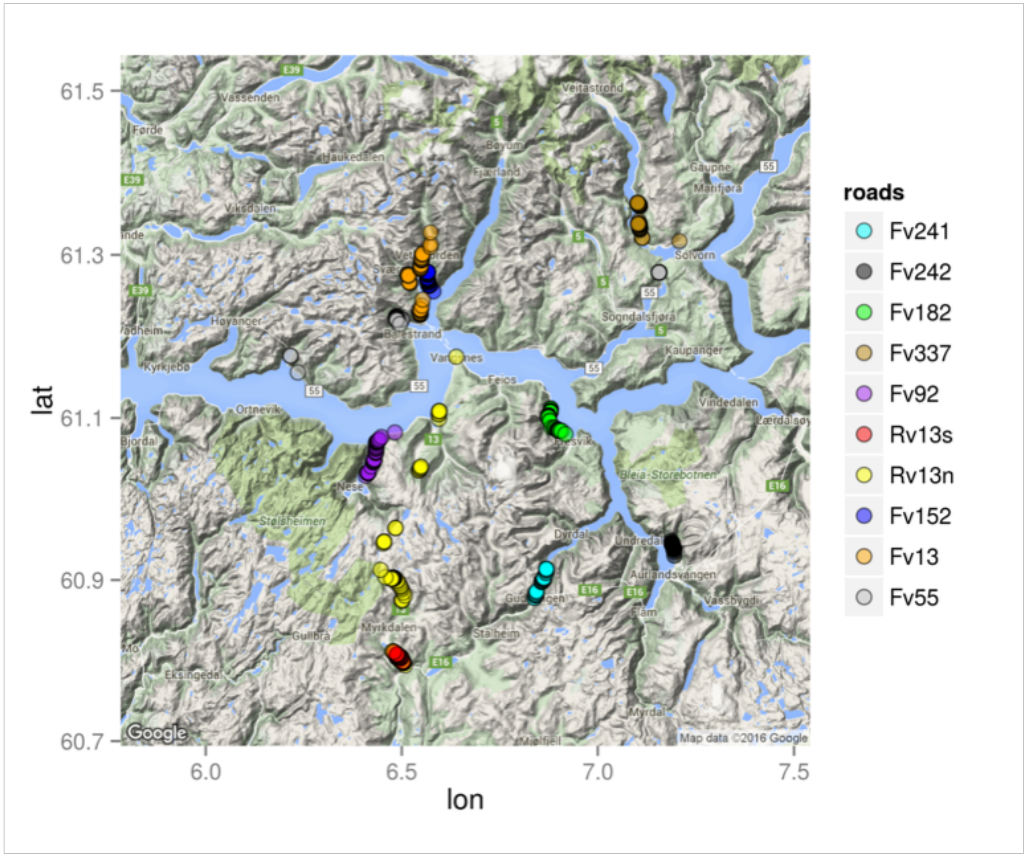
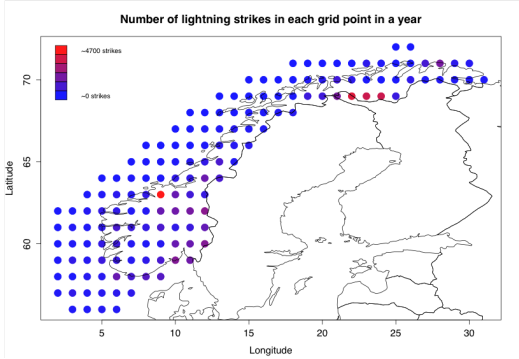


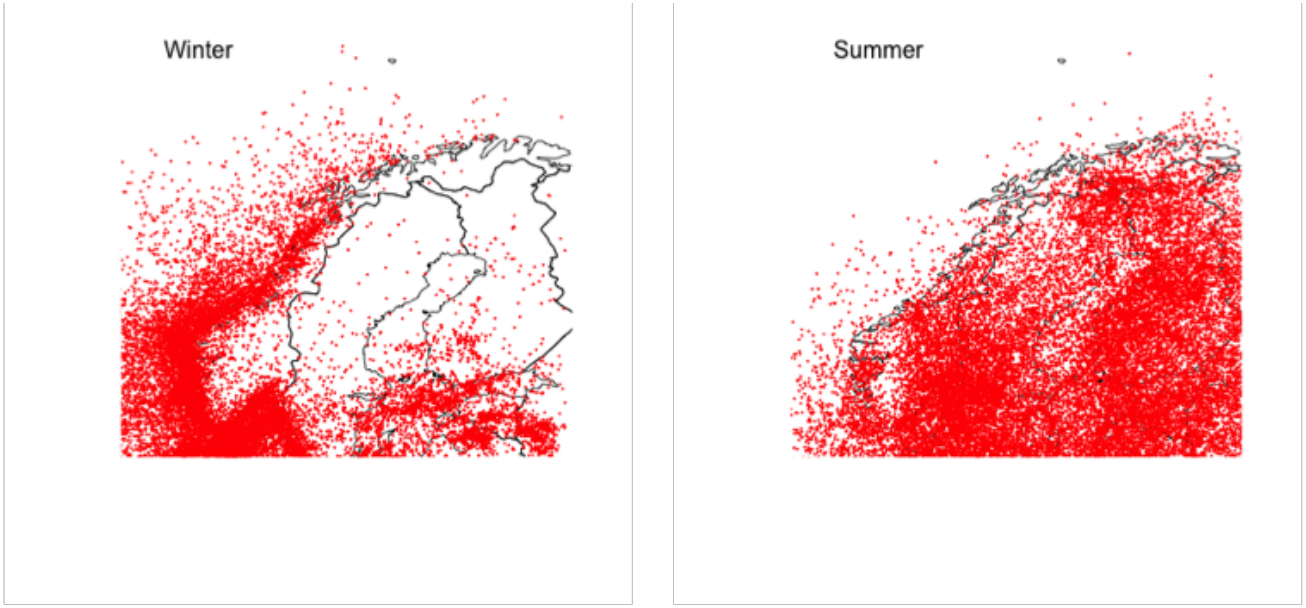
Figure 2.2: Sognefjorden with registered avalanches indicated by dots. The different colors represent different roads.

Figure 2.3: Number of lightning strikes in each grid point in a year.



2.1 Data and explanatory analysis for strikes

Each observation in the dataset is the number of lightning strikes within an area of dimension 40×40 km^2 (N) centered in a grid point s with a certain latitude and longitude, within $\pm$ 0.5 hours of time t. There are a total of 155 different grid points, (see figure 2.1). All in all there are 602,789 observations.



(a) October-March (b) April-September

Figure 2.4: Seasonal variations in lightning strikes. Both figures show random samples of 50,000 lightning strikes from the specified months over a 10 year period.

From Haakon Egdetveit Nustad's Master Thesis.

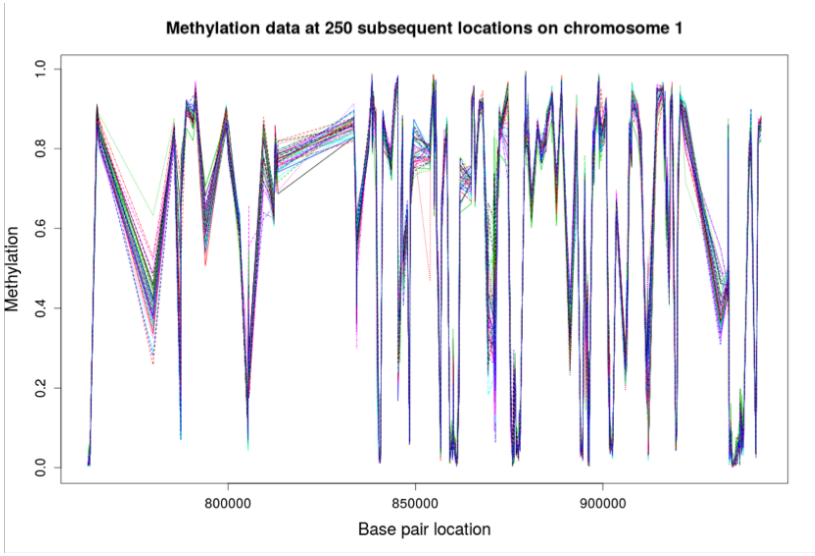


Figure 3.1: Matrix plot of methylation data at 250 subsequent locations at chromosome 1, for 40 randomly chosen people from the Schizophrenia data set.

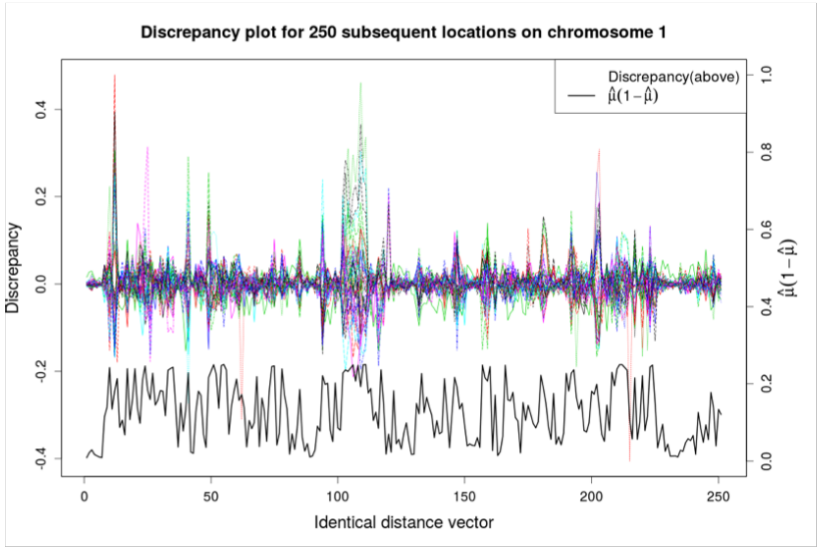


Figure 3.2: Discrepancy plot of methylation data at 250 subsequent locations at chromosome 1, for 40 randomly chosen people from the Schizophrenia data set. A function of the sample mean is plotted underneath, with axis(right hand side) chosen such that both plots are readable.

Doctor-prescription in France

From Cressie and Wikle

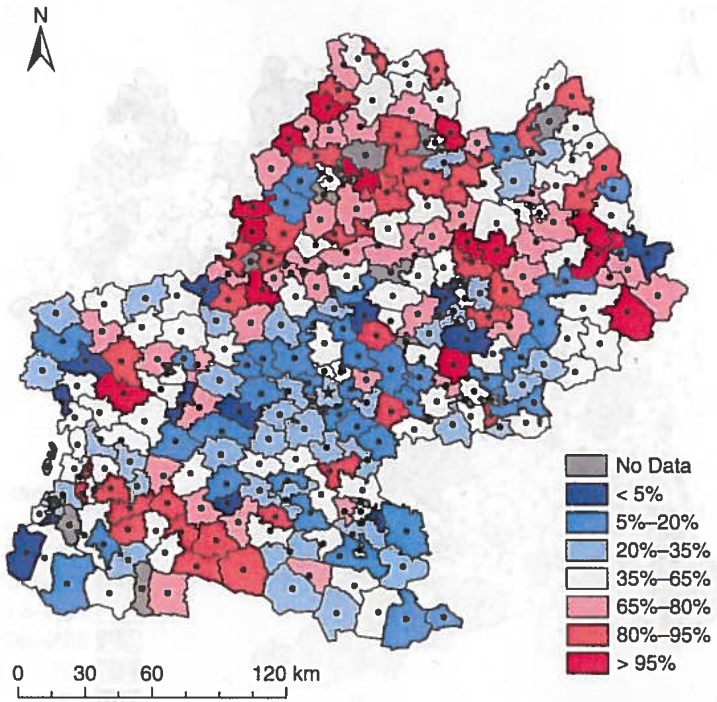


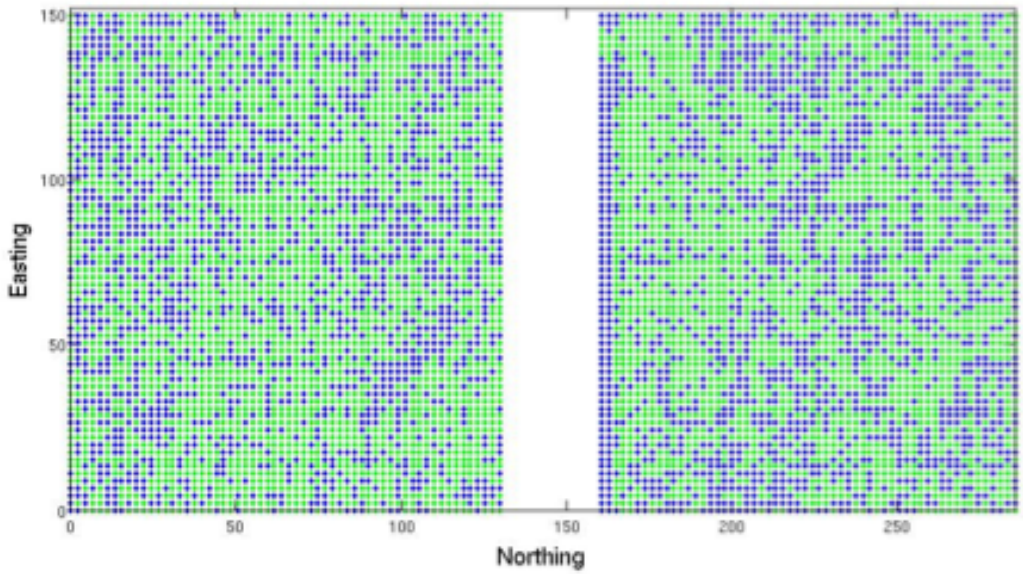
Figure 4.11 Choropleth map showing doctor-prescription amounts per consultation in the cantons of the Midi-Pyrénées (France). The "star" denotes the canton containing Toulouse. Percentiles used

Scots Pine Data

Pedigree 56 unrelated parents, partial diallel design. Original 8160 seedlings.

Spatial location 2.2×2.2m grid, two trail sites.

Data Hight and bad(1) / good(0) branch angle of 4970 26-years-old scots pine.



What is *spatial* and what is *statistics*?

Spatial

Statistics

The *science* statistics

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Spatial

A reference to location (often geo location)

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A reference to location (often geo location)

Statistics

The *science* statistics

Statistics is the science about learning from data, and measuring, control and communication of uncertainty. (Davians Louis, Science, 2012).

Statistics is a tool to make judgments and make decisions under uncertainty and variability.

Statistical model: An (idealized) model of how data has been generated.

Three parts:

Part 1: Geostatistical Processes (chapter 4.1)

Part 2: Spatial Point processes (chapter 4.3 ++)

Part 3: Lattice processes (chapter 4.2, focus on discrete Markov random fields)

Success treatment of Kidney stones (pg 12)

For all surgery

- Open surgery: Success rate 78 %
- Ultra sound: Success rate 83 %

Success treatment of Kidney stones (pg 12)

For all surgery
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For small stones:
- Open surgery: Success rate 93 %
- Ultra sound: Success rate 87 %

Success treatment of Kidney stones (pg 12)

For all surgery
- Open surgery: Success rate 78 %
- Ultra sound: Success rate 83 %

For small stones:
- Open surgery: Success rate 93 %
- Ultra sound: Success rate 87 %

For large stones:
- Open surgery: Success rate 73 %
- Ultra sound: Success rate 69 %

Success treatment of Kidney stones (pg 12)

For all surgery	• Open surgery: Success rate 78 % • Ultra sound: Success rate 83 %
For small stones:	• Open surgery: Success rate 93 % • Ultra sound: Success rate 87 %
For large stones:	• Open surgery: Success rate 73 % • Ultra sound: Success rate 69 %

Lurking variable: Patients kidney stone size

The Ecological Fallacy

Foreigne born and litteracy in US, 1930s (pg 197)

At individual level: Correlation: -0.11

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At state level: Correlation 0.53

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Foreigne born and litteracy in US, 1930s (pg 197)

At individual level: Correlation: -0.11

At state level: Correlation 0.53

Same as *Simpsons's paradox*, due to *change-of-support*, also named *ecological bias*

Before Wednsday

- Read Chapter 1, 2.1 and 2.2 in Cressie and Wikle.
- Review Multivariate Gaussian Distribution (definition and conditional probability)
- Read introduction to Chapter 4 and 4.1 in Cressie and Wikle