Projects for NMST543 Spatial statistics

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Overview

We have 8 topics, one for each student. The students decide which project they will take.

The projects include a short research part, usually a single paper. The materials will be provided by the teacher. The aim is to get familiar with a new technique / method related to the topics we have covered.

The focus is on the motivation of the method, its foundations and basic concepts, range of applicability, . . .

Details of the proofs etc. are not really important for us now.

Overview

Each method is already implemented in the *spatstat* or the *spptest* package.

The task is to “try” the method, identify the situations in which it is useful and in which it is not useful, create pictures that ilustrate what the method does etc.

The output of the project will be a script illustrating the method and a pdf file giving the necessary overview of the method, examples of its use and everything the student finds interesting.

The pdf file should be written so that a clever colleague (who knows the basics of the spatial statistics that we have covered so far) would understand the principles of the method and would be able to use it on his/her own dataset.

Overview

With all this being said it is clear that there is no “correct” or “incorrect” solution to the project. However, only serious attempts will be appreciated by the course credit.

You might also be asked to give a 15–20 minute presentation about the project in the last week of the teaching period.

Deadline for handing in the pdf files and scripts is the end of the examination period (but it is much better to do it earlier in case some changes are required).

Project I

Likelihood cross validation bandwidth selection for kernel estimation of the intensity function.

```
library(spatstat)
?bw.ppl
```

References:
Loader, C. (1999) Local Regression and Likelihood. Springer, New York. Section 5.3.

Project II

Cross validated bandwidth selection for kernel estimation of the intensity function.

```
library(spatstat)
?bw.diggle
```

References:
Berman, M. and Diggle, P. (1989) Estimating weighted integrals of the second-order intensity of a spatial point process. Journal of the Royal Statistical Society, series B 51, 81–92.
Diggle, P.J. (1985) A kernel method for smoothing point process data. Applied Statistics (Journal of the Royal Statistical Society, Series C) 34 (1985) 138–147.

Project III

Bootstrap confidence bands for summary functions.

```
library(spatstat)
?lohboot
```

References:
Loh, J.M. (2008) A valid and fast spatial bootstrap for correlation functions. The Astrophysical Journal, 681, 726–734.

Project IV

Dao-Genton adjusted goodness-of-fit test (adjusting for the conservatism in composite hypothesis testing).

```
library(spatstat)
?dg.test
```

References:

Dao, N.A. and Genton, M. (2014) A Monte Carlo adjusted goodness-of-fit test for parametric models describing spatial point patterns. Journal of Graphical and Computational Statistics 23, 497–517.

Project V

Kernel estimate of intensity function on a linear network.

```
library(spatstat)
?density.lpp
```

References:
McSwiggan, G, Baddeley, A. and Nair, G. (2016+) Kernel Density Estimation on a Linear Network. Scandinavian Journal of Statistics, Early View.

Project VI

Studentized envelopes and directional quantiles envelopes.

```
library(spptest)
?st_envelope
?qdir_envelope
```

References:
Myllymäki, M., Mrkvicka, T., Seijo, H. and Grabarnik, P. (2016) Global envelope tests for spatial processes. JRSS B, Early View. Focus on Section 3.

Project VII

Detecting anisotropy using a sector K-function.

```
library(spatstat)
?Ksector
```

References:

Moller, J. and Waagepetersen, R.P. (2004). Statistical inference and simulation for spatial point processes. Boca Raton, Chapman & Hall/CRC. Section 4.2.2.

Project VIII

Minimum contrast estimation for inhomogeneous Thomas process.

```
library(spatstat)
?rThomas
?rthin
?Kinhom
?mincontrast # with the option theoretical =
spatstatClusterModelInfo("Thomas")$K
```

References:

Waagepetersen, R.P. and Guan, Y. (2009). Two-step estimation for inhomogeneous spatial point processes. JRSS B, 71, 685–702.