Projects for NMST543 Spatial statistics

Department of Probability and Mathematical Statistics
Faculty of Mathematics and Physics
Charles University, Prague

2017/2018

Overview

We have 5 topics, each student chooses one. 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* 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 will 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

Simple boundary correction for kernel density estimation.

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

Compare diggle=TRUE/FALSE, in what sense is one of the versions “better”?

References:

Jones, M.C. (1993) Simple boundary corrections for kernel density estimation. Statistics and Computing 3, 135–146.

Project II

Second-order neighbourhood analysis of mapped point patterns.

```
library(spatstat)
?localK
?localL
```

How does the method work, what is it useful for etc.

References:
Getis, A. and Franklin, J. (1987) Second-order neighbourhood analysis of mapped point patterns. Ecology 68, 473–477.

Project III

Bootstrap confidence bands for summary functions.

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

How do they use bootstrap approach to estimate the variance of the estimates of summary characteristics?

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

Project IV

Nonparametric analysis of earthquake point-process data.

```
library(spatstat)
?sharpen.ppp
```

How does the method work, what is it useful for etc.

References:

Choi, E. and Hall, P. (2001) Nonparametric analysis of earthquake point-process data. In M. de Gunst, C. Klaassen and A. van der Vaart (eds.) State of the art in probability and statistics: Festschrift for Willem R. van Zwet, Institute of Mathematical Statistics, Beachwood, Ohio. Pages 324–344.

Project VIII

Minimum contrast estimation for inhomogeneous Thomas process.

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

How does the method work, what is it useful for etc.

References:

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