Projects for NMST543 Spatial statistics

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

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Overview

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 an *R* 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 illustrate 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

Nonparametric estimate of intensity as function of a covariate.

```
library(spatstat)
?rhohat
```

Does the intensity of a point process depend on a given covariate?

References:

Baddeley, A., Chang, Y.-M., Song, Y. and Turner, R. (2012) Nonparametric estimation of the dependence of a point process on spatial covariates. Statistics and Its Interface 5 (2), 221–236.

Project II

Lurking variable plot.

```
library(spatstat)
?lurking
```

Plot spatial point process residuals against a covariate to see if the covariate should be included in the model. The paper contains a lot of material, focus on the lurking variable plot only.

References:

Baddeley, A., Turner, R., Moller, J. and Hazelton, M. (2005) Residual analysis for spatial point processes. Journal of the Royal Statistical Society, Series B 67, 617–666.

Project III

Variance correction for random shift tests.

```
library(NTSS)
?PC.test
```

Focus on the variance correction approach for random shift tests, with the specific application to testing the dependence between a point process and a covariate.

References:
J. Dvořák, T. Mrkvička, J. Mateu, J.A. González (2022): Nonparametric testing of the dependence structure among points-marks-covariates in spatial point patterns. International Statistical Review 90(3), 592-621.

Project IV

Bandwidth selection for estimation of pair-correlation function.

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

References:

Jalilian, A. and Waagepetersen, R. (2018). Fast bandwidth selection for estimation of the pair correlation function. Journal of Statistical Computation and Simulation 88 (10), 2001–2011.

Project V

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.