Final Semester Project

Write a scientific paper on Bayesian methods for spatial statistics with applications to real data. Describe the problem, the data and the objectives of your analysis. Describe the methodology and algorithms. Give details on specification of your prior distributions, algorithms and computational costs. Discuss further questions that might have been raised by your study and how they might be investigated in a future work.

The work must include at least the following sections,

1. First page: title, author and abstract.
2. First Section: Introduction.
3. Last Section: Discussion.
4. Bibliography (use bibtex)

Also,

- The work must be written in Latex with a final format Adobe PDF (use the file name yourlastname-report.pdf).
- It should have no more than 15 1.5-spaced pages (not including listings of raw data, computer output and computer code).
- All figures and tables included must be commented.

The paper that you are preparing or have submmited with your supervisor is not acceptable. This work must be as original as possible and should have the potential to become a real paper. Plagiarism checkers will be employed. Do not use tables and figures from other papers.

Reminder: You cannot write papers if you do not read papers.

Interesting Topics

Estimating the evidence in spatial models

The model evidence is a vital quantity in the comparison of statistical models under the Bayesian paradigm. In this project you can review commonly used methods to estimate evidence as in Friel and Wyse [2012] and Vehtari and Ojanen [2012]. How can one properly account for spatial structures when using these quantities while keeping computational costs acceptable? A recent proposal concernig cross-validation methods appeared in Bürkner et al. [2020].

Bayesian computations for doubly-intractable problems

While MCMC methods are routinely used to draw samples from posterior distributions they do not apply to doubly intractable distributions where parameter dependent normalization terms are present. In this work you can investigate methods recently proposed to deal with such problems in spatial statistics. See for example Lyne et al. [2015] and Everitt et al. [2017].

Hamiltonian Monte Carlo methods

Hamiltonian Monte Carlo (HMC) and related algorithms have become routinely used in Bayesian computation. In this work you can describe methods to improve the efficiency of HMC and related algorithms with acceptable computational costs. See for example Nishimura and Dunson [2020] and Stoehr et al. [2019].

Regularization from a Bayesian viewpoint

Compare regularization methods and discuss them from a Bayesian viewpoint (see for example, Tibshirani [1996], Park and Casella [2008]). Also explore the spike and slab approaches (Rocková and George [2018], Ishwaran and Rao [2005]) and horse-shoe priors (Carvalho et al. [2010]).

References

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