Spatial Data Science Fall 2020 (MATH 432/532)

Course project guidelines

- This short project can be submitted in place of the final exam in the course. It will be due by midnight the same day as the date for final exam.

- Please submit your report in pdf format to canvas. You also submit additional materials if needed in separate files.

- Contact me at any stage in this work to get an idea of a good project, scope, or how to distill your results.

Project description

This assignment should explore some focused topic related to spatial data or spatial methods. The project should be organized around answering a particular question. If your project centers around a data set it is important that you consider a topic where someone might care about the results. It is better to tackle an interesting question and conclude that the spatial methods are not effective or needed instead of forcing a data set in to a spatial analysis. Write me if you would like a suggestion for a data set.

Some project examples are:

- For a given spatial data set is there a spatial signal in addition to a linear model based on relevant covariates?

- For a given data set what is the predicted field and prediction standard errors for a set of locations on a grid.

- Given a particular spatial model and a set of locations how accurately can the covariance parameters be estimated? (This question can be answered using a Monte Carlo study.)

- Comparing exact and approximate methods in terms of timing for

- Comparing the results from a frequentist analysis to a Bayesian analysis for a spatial data set.

- A short research essay on a topic related to statistical or computational methods. E.g.

  - *The history of the concept of a Gaussian process.*
  - *What is the current state-of-the-art for fitting very large spatial data sets?*
  - *How are the methods and models for point spatial processes different from continuous spatial data?*
  - *Examples of multivariate spatial models.*

Report format

The report should be limited to approximately 3-5 pages single spaced and 2-4 tables or figures. Including R code is not necessary and in most cases will detract from presenting

the results. It is OK *not* to include everything you have done. Pick and choose the most salient points of your efforts and tell a clear story. For example if the residuals look OK just report that – no need to include a residual plot.

You might want to follow the report outline below.

1. Statement of the project topic and the primary question.
2. Data Description
   Be sure to give enough of a reference where a reader/student in this class can assess the data and reproduce your analysis.
3. Statistical and graphical methods used
4. Results and conclusion Make sure you give a succinct conclusion that addresses your question. If you are doing a spatial analysis it make be useful to include the estimates of regression parameters and the variance and range parameters in your results.
5. Possible directions or issues for future analysis.

Often one or two well designed figures can communicate the results of a study or analysis. If you do use figures make sure they are described well in your text and you point out the key feature that make them important. Don't expect the reader to figure out the details of the plot on their own.

Tips on writing

The challenge in writing an effective report is giving enough detail so a reader can reproduce what you did, but not too much detail that makes the report long and confusing. Often lacking in a report is a clear statement of the goal of the data analysis and a crisp summary of conclusions. It is easy to miss these parts – in the midst of a data analysis these points are usually so obvious it is easy to forget to step back and delineate them.

Finally, consider the advice from Strunk and White, *The Elements of Style*

> Vigorous writing is concise. A sentence should contain no unnecessary words, a paragraph no unnecessary sentences, for the same reason that a drawing should have no unnecessary lines and a machine no unnecessary parts.
>
> This requires not that writers make all their sentences short, or that they avoid all detail and treat their subjects only in outline, but that they make every word tell.