STA465/ STA2016: THEORY AND METHODS FOR COMPLEX SPATIAL DATA (WINTER 2022)

Instructor: Dr. Vianey Leos Barajas

TA: Nnenna Asidianya

Lectures: Wednesday 12:10–13:00
Friday 11:10–13:00
Gailbrath building #119

Online:
https://utoronto.zoom.us/j/85172816221
Passcode: 444598

Office Hours: Thursday 14:00-15:00 (Excluding week 1)
Other times by appointment only

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Questions about the course content/homework and sending an email:

Questions about the homework or course content should be posted on Quercus. In general, I am not able to answer questions about the course material by e-mail. Before you send an e-mail, make sure that you are not asking for information that is already on the course web site, syllabus or questions about the course material or assignments that are more appropriately discussed in tutorial or during office hours. If you do not get a response, this may be why.

E-mail is appropriate for private communication. Use your utoronto.ca account to ensure that your message does not automatically go to my junk folder. When sending an e-mail, please follow professional e-mail etiquette, use STA465/STA2016 as the subject line, and be specific about what it is you need from me – this will help me respond in a timely manner. An example below:

Subject line: STA465/STA2016

Content:

Dr. Leos Barajas,

I would like to know more about the theoretical foundations of the methods used in the software INLA. Do you have any books you would recommend on the topic?

Best/Thank you/Other appropriate way to close an email

(Insert your name here)

Announcements will be posted on Quercus. Please check there regularly. If an urgent matter arises, I may contact the entire class by e-mail. In order to receive these messages, please make sure that your ROSI account has your utoronto.ca e-mail.

Assessment:

	WEIGHT	DATE	TIME
HOMEWORK 1	25%	28 January	Beginning of class
HOMEWORK 2	25%	18 February	Beginning of class
HOMEWORK 3	25%	11 March	Beginning of class
HOMEWORK 4	25%	8 April	Beginning of class
FINAL EXAM (OPTIONAL)	25%	Final exam window	

The assignments will each be a data analysis project for which you will use R and, for some, the software INLA (in R) as well. Any requests to have marked work re-evaluated must be made in writing within two weeks of the date the work was returned to the class. The request must contain a justification for consideration.

Grade calculation: Each homework assignment is worth 25% of your overall grade. The final exam is optional. If the final exam is taken, the lowest score of the homeworks and final exam will be dropped when computing the overall grade. This should provide some flexibility in case there is an emergency during the term and one of the homeworks can not be completed for any reason.

Late homework policy:

Late homework will generally not be accepted, unless a prior arrangement has been made.

Re-grading policy:

Regrading requests should only be made for genuine grading errors, and should be initiated by writing or typing a complete explanation of your concern (together with your full name, student number, and e-mail address) on a separate piece of paper, and giving this together with your original unaltered homework/test paper to the instructor within two weeks of when the graded item was first available. Warning: your mark may end up going down rather than up.

Textbook and slides:

- This course has no specific textbook, however the following four books, which are electronically available from the library and online, will be referred to on occasion:
    - *Geospatial Health Data: Modeling and Visualization with R-INLA and Shiny* by Paula Moraga
    - *Bayesian Inference with INLA by Virgilio Gomez Rubio*
    - *Spatial and spatio-temporal Bayesian models with R-INLA* by Marta Blangiardo and Michela Cameletti
    - *Statistical Analysis and Modelling of Spatial Point Patterns* by Janine Illian, Antti Penttinen, Helga Stoyan, and Dietrich Stoyan
- Further information will be contained in slides, handouts, and specific references that will be available on Quercus before classes.

Computing:

- The course will be run using the R computing environment.
- This course will use the R package INLA. This is not available from CRAN but can be installed into R using the command
  install.packages("INLA", repos=c(getOption("repos"), INLA="https://inla.r-inla-download.org/R/testing"), dep=TRUE)
- You are strongly encouraged to use RStudio (https://www.rstudio.com), which is a free IDE for R.
- All instructions in the course will assume that you have the latest version of both RStudio and R installed. We will not answer any R related questions unless both of these things are true.

Course outline:

This course will cover practical and theoretical aspects relevant to the analysis of spatial data. The course will cover ***some*** of the following topics:

- Linear regression as a Bayesian model
- Multivariate Gaussian distributions and conditional independence
- Bayesian multilevel models
- Models for areal data
- Model checking, validation, and workflow
- Gaussian random fields in theory and practice
- Modelling non-Gaussian spatial data
- Point processes and log-Gaussian Cox processes

Accessibility:

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or Accessibility Services as soon as possible.
https://studentlife.utoronto.ca/wp-content/uploads/Accessibility-Services-Undergraduate-Handbook-2021-2022.pdf

Additional Resources:

- Big book of R: https://www.bigbookofr.com/index.html
- Geocomputation with R: https://geocompr.robinlovelace.net
- **rspatialdata**: a collection of data sources and tutorials on visualising spatial data using R: https://rspatialdata.github.io
- *Spatio-Temporal Statistics with R by* Christopher K. Wikle, Andrew Zasmmit-Mangion, and Noel Cressie