Spring 2023
STAT 8025 Spatial Statistics

Instructor: Dr. Emily Lei Kang
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Website: Canvas

When: M W F 11:15 AM – 12:10 PM
Where: Rm 4211 French Hall
Office Hours: M 12:30PM – 1:30PM
T R 9 AM- 10AM via Zoom
(or by appointment)

Course Description
This 3-credit graduate-level course will provide an introduction to spatial statistical methods for geostatistical and lattice data. Among the topics considered are spatial covariance functions, variograms, kriging, spatial simultaneous and conditional autoregressive models, spatio-temporal statistical models and methods for analyzing massive spatial and spatio-temporal datasets. Applications of these methods will be discussed to illustrate the methodologies. Students are responsible for all material covered in the class (including material posted on Canvas), in the assigned readings and in homework assignments.

Assumed Background Knowledge
Prerequisite: Math Stat, Applied Stat, Linear Models; or permission of instructor. Students are assumed to have knowledge of algebra (especially matrix theory) and linear regression models. Computing skills and experience with statistical software are also expected.

Recommended Textbooks
Cressie (1993). Statistics for Spatial Data. Wiley & Sons. ("Bible of spatial statistics" but at advance level; available at UC libraries)

Lance A. Waller and Carol A. Gotway (2004). *Applied Spatial Statistics for Public Health Data.* Wiley, New York. (A good reference book at basis level)

Roger S. Bivand, Edzer J. Pebesma, and V. Gmez-Rubio (2008). *Applied Spatial Data Analysis with R.* Springer, New York. (A helpful book with R examples; available at UC libraries)

Kitanidis (1997). *Introduction to Geostatistics.* University Press. (A good book for the geostatistics part of this course; available at UC libraries)

Gelfand, Diggle, Fuentes, Guttorp (2010). *The Handbook of Spatial Statistics.* Chapman & Hall/CRC. (Another nice reference book; available at UC libraries)

Computing
This course emphasizes methodologies but not coding. R will be used in some lectures. It can be downloaded free at `http://www.r-project.org/`, available for PC, Mac or Linux machines. Students feel free to choose other software such as Python, Julia to implement methods introduced in this course.

Homework
Homework will be announced in the class and Canvas. While I encourage students to work together and learn from each other, the work you turn in must be your own.
Students should upload their homework to Gradescope by the due date. This is the only acceptable way to turn in homework (do not leave homework assignments under instructor's office door

or email electronic copies). **No late assignments will be accepted unless there are extreme and documentable circumstances that are approved by the instructor**.

In order to get the full credits, you must show your work for all assigned homework problems; **do not just write the final answer**. Answers without adequate explanations will not receive full credits. When required, computing codes should also be attached to the end of homework.

Students are encouraged to write homework with LaTeX. For each homework, *10% of the grade is based on its professional appearance.*

Exam
The Midterm exam is tentatively scheduled for Wednesday February, 22. This exam will be a take-home project, and students will turn in a short research report for their analysis of a spatial data set. More details will be announced later in class and on Canvas.

Final Project
A final project is required for this course:
1. Students need to first turn in their **one-page proposals of the project by the deadline of March 20, Monday**. This proposal should contain the goals of the study and basic approached to be utilized. Although students can choose subjects and datasets interest them (for example, topics related to their dissertations), they should not use the same topics they have already done. In addition, this project proposal does not need to take a lot of time in data collection or extremely expensive computation, but students need to show in their proposal (and their final report/presentation) the ability of careful planning and good understanding of concepts covered in the course. This is called the data-analysis track. Students can also present a published paper for the final project which is called the paper track). If this is the case, students should discuss with the instructor and ask the instructor to assign a paper. For projects in the paper track, students need not only reproduce results in the paper but also discuss potential limitations and new applications and examples for the methods proposed in the paper.
2. **A final report for the project is due 11:59PM April 24, Monday**. This report should contain: motivation and introduction of the problem under study, descriptions of data/methods, major findings, discussion of implications of the study and further questions to be addressed. For the paper track projects, the report should contain nicely organized sections summarizing the major contributions and results in the paper and also discussion on potential limitations, new developments, and new applications and examples.
3. During **April 17, 19 and 21 (tentative)**, students will give **oral presentations** of their work in the final project.

The scores of the final project will be assigned based on: quality of the analysis and novelty of methodology (50%), clarity and professional appearance of the report (30%), and oral presentation (20%).

Final Grade
The final course grade will be based on the following weighting of assessment components:

Attendance & Class participation	Homework	Midterm	Final Project
5%	30%	30%	35%

Your final course letter grade will be assigned according to the following grading scale:

		B+	87 – 89	C+	77 – 79	D+	67 – 69		
A	93 – 100	B	83 – 86	C	73 – 76	D	63 – 66		
A-	90 – 92	B-	80 – 82	C-	70 – 72	D-	60 – 62	F	below 60

Email Correspondence
The best way to contact the instructor is via email (kangel@ucmail.uc.edu). All course email correspondence must be done via UC email accounts, and I cannot send email to other accounts, such as yahoo, gmail, etc.

Communication Devices
Personal communication devices such as cell phones must be **either turned off or put on vibrate** during class. Additionally, please refrain from texting during class.

Academic Integrity
Please help maintain an academic environment of mutual respect and fair treatment. You are expected to produce original and independent work on the exams. For homework, group work is encouraged. However, it is plagiarism to copy someone else's work and call it your own. All students must submit their own written work in their own words. Academic misconduct **will not** be tolerated.

Issues of Differing Abilities
Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of those available accommodations, students must contact the Disability Services Office at 210 University Pavilion (513-556-6823). `http://www.uc.edu/aess/disability.html`.

Drop and Withdraw Dates
The last day to drop without entry to academic record is January 23. The last day to withdraw is April 7.

Holidays
There will be no class on the following days:
Dr. Martin Luther King Jr.'s Birthday: Monday, January 16
Spring break: Monday – Sunday, March 13 – 19, 2023

Receiving an 'I' for the Course
You cannot receive an incomplete for the course unless 70% of the work in the course (especially the attendance) has been completed. Extenuating circumstances will be handled on a case-by-case basis.

Tentative Schedule

Week	Topic
Week 1	Introduction & Spatial Processes
Week 2	Variogram and Covariance
Week 3	Model Fitting
Week 4	Kriging
Week 5	Krging with Extensions
Week 6	Krging with Extensions
Week 7	Lattice Data
Week 8	Models for Lattice Data (CAR)
Week 9	Models for Lattice Data (SAR)
Week 10	Applications and Extensions
Week 11	Spatial Statistics for Large Datasets
Week 12	Spatial Statistics for Large Datasets
Week 13	Introduction to Point-Pattern Data
Week 14	Models and Testing for Point-Pattern Data
Week 15	Applications and Extensions

Note: The instructor reserves the right to change the class syllabus to meet class needs.

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I read the entire course syllabus thoroughly and will obey the policies for this course through the semester.

Name (Last, First): _____

Major: _____

Graduate-Level Math/Stat Courses Taken:

Signature: _____

Date: _____