Course Information for
STAT:6530 "Environmental and Spatial Statistics"

Spring 2019

Instructor
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Course Format
Lectures 2:30 – 3:20 MWF in 3 SH. Occasionally we may meet instead in the Statistics
Graduate Computing Lab, 346 SH.

Office Hours
10:30 – noon Tuesdays and Thursdays, or by appointment

Department Information
Department of Statistics and Actuarial Science, 241 Schaeffer Hall, Phone 335-2082

Department Executive Officer
Professor Joseph Lang, 241 SH, Phone 335-0712, E-mail joseph-lang@uiowa.edu

Textbook
For the entire course, lecture notes, freely provided for download from Professor Zimmer-
man's webpage, will serve as a quasi-textbook. For the first 50-60% of the course, the lecture
notes will be supplemented by assigned readings from *Model-Based Geostatistics*, by P.J. Dig-
gle and P.J. Ribeiro (2007, Springer). It is strongly recommended that students purchase
this book. For the second half of the course, the lecture notes will be supplemented with
assigned readings from sources provided by Professor Zimmerman.

Course Prerequisites
22S:152 (or equivalent) and 22S:154 (or equivalent).

Course Objectives
To learn some of the most important methods for explicitly accounting for time and space
(mostly the latter) in the statistical analysis of environmental data. In addition to learning
the methods, it is our goal to learn when and why they are appropriate, what the underly-
ing assumptions are, and how to implement the methods using various statistical software
packages. With rare exceptions, we will not be concerned with deriving the methods us-
ing statistical theory, but we will occasionally use statistical theory to obtain statistical
properties of the methods.

   Students taking this course are mainly of two types: (1) Statistics M.S. and Ph.D. stu-
dents, who have had courses more advanced than the prerequisites for this course; (2) Gradu-
ate students from Geography, Civil Engineering, and other fields who barely have (or in some
cases simply don't have) the necessary course prerequisites. Currently, we need students of

both types in order to have healthy enrollment for the course. The course objectives differ slightly for the two groups: the first group needs a theoretical understanding of the statistical methodology, while the second does not. Accordingly, the course content includes some theory, but homework and exam problems requiring more advanced theory will be assigned to only the first group; those problems will be replaced with more applied problems for the second group.

Major Topics Covered

- Trends, variability, and correlation

- Exploratory temporal and spatial data analysis

- Geostatistical models, including covariance functions and semivariograms

- Semivariogram and covariance function estimation

- Kriging (spatial prediction)

- Spatial regression

- Geostatistics on river networks

- Lattice (areal) data analysis, including measures of spatial autocorrelation and disease mapping

- Spatial point pattern analysis: univariate

- Spatial point pattern analysis: multivariate

- Methods for sampling environmental populations (time permitting)

Computing

Substantial computing will be necessary to complete many homework assignments and the final project. Our software of choice will be R, but we may use SAS occasionally. Instructions on their use will be provided in class.

Homework

Written homework assignments are an essential component of the course. Assignments will be given approximately every week to 10 days, except around the times of exams or projects. Assignments must be turned in at the beginning of class on the day they are due. Unless prior arrangements are made, homework turned in late will receive a score no higher than 50%. You may work on homework problems together, but outright plagiarism is prohibited. Each student must write up their own work.

   Some assignments will involve the analysis of data using a computer. Any computer output you wish to include with your homework should be fully labeled and annotated, and should be integrated with other parts of the homework by electronically cutting and pasting.

   Some homework assignments may include some problems assigned only to Statistics graduate students, and other problems assigned only to non-Statistics graduate students. Every effort is made to "equalize" these assignments.

<u>Attendance</u>
Attendance at lectures and participation in discussions are expected. Coming late to class, leaving early, or failing to attend class often will lower your grade.

<u>Midterm Exams</u>
Two in-class midterm exams will be given; the first in early March, and the second in late April. These exams will be "closed-book" but "open-notes," meaning that during the exam you can look at your lecture notes, past homework assignments, and anything else that you have written, but you may not look at other printed or electronic materials. As with homeworks, some exam problems may be assigned only to Statistics graduate students and others only to non-Statistics graduate students.

<u>Data Analysis/Simulation Projects</u>
Two data analysis/simulation projects will be given during the semester. The first will be handed out in early March and due in late March; the second will be handed out in late April and due by the final exam time assigned to our course. (We won't have an in-class final exam; the second project can, if you wish, be regarded as taking the place of a final exam.) These projects will involve a more complete, in-depth analysis of a spatial dataset or a spatial statistics topic than is typical of a problem on a homework assignment. In contrast to homework assignments, you must work independently and not communicate with other class members about the projects.

<u>Grading</u>

- Homework and Attendance, 30%

- Midterm Exams, 40% (20% each)

- Data Analysis/Simulation Projects, 30% (15% each)

Plus-minus grading will be used.

<u>Classroom Environment</u>
Activities in class which are unacceptable are (1) prolonged conversation with a fellow student, (2) the use of cell phones, and (3) the use of laptops/tablets etc. Please remember to switch your cell phones to silent mode before class starts and put away laptops/tablets/phones etc. when in class.

<u>Administrative Home</u>
The College of Liberal Arts and Sciences (CLAS) is the administrative home of this course and governs its add/drop deadlines, the second-grade-only option, and other policies. These policies vary by college (https://clas.uiowa.edu/students/handbook).

<u>Electronic Communication</u>
Students are responsible for official correspondences sent to their UI email address (uiowa.edu) and must use this address for all communication within UI (Operations Manual, III.15.2).

<u>Accommodations for Disabilities</u>

UI is committed to an educational experience that is accessible to all students. A student may request academic accommodations for a disability (such as mental health, attention, learning, vision, and physical or health-related condition) by registering with Student Disability Services (SDS). The student should then discuss accommodations with the course instructor (https://sds.studentlife.uiowa.edu/).

Nondiscrimination in the Classroom
UI is committed to making the classroom a respectful and inclusive space for all people irrespective of their gender, sexual, racial, religious or other identities. Toward this goal, students are invited to optionally share their preferred names and pronouns with their instructors and classmates. The University of Iowa prohibits discrimination and harassment against individuals on the basis of race, class, gender, sexual orientation, national origin, and other identity categories set forth in the Universitys Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity at diversity@uiowa.edu or diversity.uiowa.edu.

Academic Integrity
All undergraduates enrolled in courses offered by CLAS have, in essence, agreed to the College's Code of Academic Honesty. Misconduct is reported to the College, resulting in suspension or other sanctions, with sanctions communicated with the student through the UI email address.

CLAS Final Examination Policies
The final exam schedule for each semester is announced around the fifth week of classes; students are responsible for knowing the date, time, and place of a final exam. Students should not make travel plans until knowing this final exam information. No exams of any kind are allowed the week before finals. (https://clas.uiowa.edu/faculty/teaching-policies-resources-examination-policies.)

Making a Complaint
Students with a complaint should first visit with the instructor or course supervisor and then with the departmental executive officer (DEO), also known as the Chair. Students may then bring the concern to CLAS (https://clas.uiowa.edu/students/handbook/student-rights-responsibilities).

Understanding Sexual Harassment
Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community must uphold the UI mission and contribute to a safe environment that enhances learning. Incidents of sexual harassment must be reported immediately. For assistance, definitions, and the full University policy, see https://osmrc.uiowa.edu/.