Spatial Data Analysis
Winter School in Methods and Data Analysis UCU-DCSP
Master in Public Policy Program
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Course Description and Goals

This course considers statistical techniques to evaluate social processes occurring in geographic space. The course introduces students to methods for spatial data analysis and to the applications of these methods. Coverage will include the study of point referenced observations (e.g., observations referenced in latitude and longitude), areal data models (e.g., border-referenced data), and point process models (where the location of events in latitude and longitude is the outcome itself). We also will consider models that allow for a spatial lag as a predictor. We will learn not only how to construct these models but also how to use them in applied analysis.

Heavy emphasis will be given to fundamental concepts and applied work. Prerequisites for the course include a solid understanding of the fundamentals of statistical inference, regression analysis, matrix algebra, and the general linear model.

By the end of the course, you should be able to:

• Manage point-referenced and areal data using software such as WinBUGS and R.
• Estimate models for point and block-referenced data in a variety of frameworks.
• Analytically show how frequentist, hierarchical, and Bayesian models of spatial data are specified and estimated.
• Estimate a point pattern model.

Reading

There are two required books:


Academic Integrity

Academic integrity is a core value of institutions of higher learning. It is your responsibility to avoid plagiarism, cheating, and dishonesty. Homework assignments can (and should) be done with others provided every keystroke of the final copy is your own.
Course Requirements and Evaluation

Every class will require you to read as well as solve problems, conduct analysis with software, or write ahead of time to prepare. I will distribute five homework assignments, each one class ahead of time. With homework assignments, you are encouraged to work together. However, you need to turn in your own solution set, typed and legible, where each keystroke is your own. These assignments are due in person at the start of class. No late work will be accepted on any assignment. Your final grade will be based on the sum of points earned from the homework assignments. Each assignment is worth 20 points. Grades will be based on how many points you earn according to the following distribution:

- “Passing” D =60-69 pts.
- “Failure” F =fewer than 60 pts.

Course Schedule

13 July: Overview of Spatial Data Problems and Regression-Based Approaches
Reading: Banerjee, Carlin, & Gelfand, Chapter 1 and all of Ward & Gleditsch

14 July: Point-Referenced Data Models
Reading: Banerjee, Carlin, & Gelfand, Chapters 2-3

15 July: Areal Data Models.
Reading: Banerjee, Carlin, & Gelfand, Chapter 4

16 July: Point Pattern Analysis
Reading: Banerjee, Carlin, & Gelfand, Chapter 8

17 July: Spatial Misalignment
Reading: Banerjee, Carlin, & Gelfand, Chapter 7

18 July: Additional depth on a previous topic or one of the three alternative topics listed below.

Alternative topics:
Basics of Bayesian Inference
Reading: Banerjee, Carlin, & Gelfand, Chapter 5

Hierarchical Modeling for Univariate Spatial Data
Reading: Banerjee, Carlin, & Gelfand, Chapter 6

Multivariate Spatial Modeling
Reading: Banerjee, Carlin, & Gelfand, Chapters 9-10