CUSP-GX 7002: Urban spatial analytics

Fall semester, 2019

Instructor

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Office Hours location: 2nd floor lounge of GCASL, 238 Thompson St. (Washington Square campus)

Class meeting times

Section	*Description*	*Room*	*Day and time*
CUSP-GX-7002	Main lecture (Torrens)	2MTC_820	Monday, 10:30a to 12:00p
CUSP-GX-7002	Lab (Torrens)	2MTC_813	Monday, 12:15p to 1:15p
CUSP-GX-7002	Lab (Hansen)	WSQ	Monday, 6:00p to 7:00p

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Course description

(Note: the course description that appears in *Albert* is from a previous instance of the course and is not appropriate for this course. The current and appropriate course description for this course appears below.)

> In this course, students will learn how spatial analysis can support the exploration of geographical properties, patterns, and phenomena in urban context. The course will cover the foundations of spatial analysis in the spatial sciences, examining in particular how spatial science influences data collection, data modeling, data analysis, and data interpretation. The course will explore the derivation of core spatial statistics and geostatistics that are routinely used in geographical analysis. The course will also examine the use of spatial analysis in supporting spatial modeling. The course is rooted in an exploration of the theory underpinning spatial analysis and the derivation of analysis schemes, rather than hands-on software training. Students are expected to have undertaken prior coursework in Geographic Information Systems and exploratory spatial data analysis, as well as introductory multivariate statistics. Example sets in the course will focus on urban analysis.

Course objectives

This course will introduce you to introductory topics in spatial analysis. **Assuming a base understanding of Geographic Information Systems (GIS) as a platform or accessing, organizing, and displaying spatial data and spatial relationships**, the course will focus on the derivation of several classes of spatial analysis that follow from common spatial data types or geographical contexts. The course seeks to provide you with a fundamental understanding of the core principles at the foundation of spatial analysis as well as some of the outstanding research and development opportunities and challenges for the field.

In particular, the course will cover geographical patterns and processes that motivate spatial analysis, and associated considerations for spatial data and data models, as the basis for understanding more focused spatial analysis techniques and routines. The course will then cover specific spatial analysis techniques that broadly illustrate the types of information products that can be produced atop spatial data, or that can add value to other forms of analysis.

Throughout, the course will focus on the theoretical derivation and conditions for spatial analysis, rather than software implementations. The reason for this is quite straightforward, but important. The field of GIS and related activities in geospatial analysis moves very quickly, and software platforms come and go with frequency. It is important that one has a good understanding of what is possible and what goes on “under the hood” of these systems, so that one can assess the relative merits and usefulness of software products, and particularly so that one can develop spatial analysis strategies to suit a particular scenario.

By the end of this course, you should expect to have gained proficiency in the fundamentals of spatial analysis and the ability to assess what analyses can be usefully performed with a particular set of data or with a particular set of geographical problems. This is a foundation that can be used in a variety of higher-level coursework in spatial analysis, spatial data science, and GIS.

Course pedagogy

Pedagogically, my intent with this course is to provide you with a broad review of fundamental concepts in and of spatial analysis, which is a large intellectual (and practical, applied) field that often encompasses many disciplines beyond the geographical sciences. To build a broad picture of the field often requires that you draw on particular analysis techniques or considerations from a large pool of disciplines: this requires some breadth as well as depth in review. We will therefore cover the key topics in spatial analysis at an introductory level of detail in class. For the most part, this will involve covering the key concepts and definitions per topic in-class, and discussing some examples. The course is cumulative, in that we will first cover key concepts, which will appear throughout the course in different contexts. It is therefore quite important that you keep-up with the course as we go along.

Spatial analysis is a broad field and no single textbook will cover the topic adequately. I will suggest one textbook and targeted readings to provide you with (1) more depth on particular topics that we cover in class; (and 2) supporting material and additional case studies. These readings are ancillary to the lectures: the course is not based on a textbook, and the readings will provide more context and examples (and in some instances more depth) than the lecture material.

The graded work in the course is designed to help you to focus your studies in the course by, essentially, providing a skeleton around which you should organize your coursework. It is also designed to help you retain the knowledge that you gain in the course after the course is completed.

Project-based assignments: will require you to apply some of the theoretical work we have covered in-class to research design, data collection, software analysis, and (ultimately) to problem-solving with and through spatial analysis. This will involve independent research, project work, writing-up your project design and key findings, and presentation of your results in-class.

A course-wide paper: will pose a broad question for you to answer in essay format, to give you the opportunity to think creatively about the topics that you have learned through the course, and to apply that thinking to an area that is of interest to you.

We will also engage in some in-class "**thought experiments**" that are designed to (1) interrupt the monotony of sitting in front of powerpoint slides week after week, (2) provide you with the ability to learn about spatial analysis by learning how other people apply their spatial thinking to the world around them.

Coursework

Your performance in the course will be evaluated in the context of two intra-semester projects and a course-wide paper. The intent of the coursework is to test your knowledge of key aspects of the material that we review in-class and in readings, and to encourage you to think about how you might apply that knowledge beyond the confines of what we have reviewed.

> **Project 1 (one third of your grade)**: you will be invited to perform fieldwork to survey an urban space, design a basemap representing the geography of that space, and build that basemap in a GIS. The goal of the project is to focus your attention on the types of spaces that one might encounter in urban settings, and how the geography of those spaces could (or could not) be formalized in a GIS designed as the foundation for spatial analysis.

Project 2 (one third of your grade): you will be invited to perform a targeted spatial analysis of an urban space, using mixtures of primary and secondary data.

In the case of both project 1 and project 2, you will be asked to prepare a class presentation and a written report. For Project 1 and Project 2, the report should be ~1,000 words excluding references.

Course-wide paper (one third of your grade): you will be asked one broad and open-ended question and invited to respond in essay format; it is expected that you rely on literature and research of your own to prepare the essay. The course-wide paper should be ~2,000 words excluding references.

Please note that **concerns about your grade should be brought to my attention as soon as possible.** Unless explicitly stated otherwise, all presentations must be attended in-person in class and completed within the allotted time. Please note that there is no extra-credit offered for this course.

Suggested reading material

The suggested books for this course provide a theoretical/methodological backdrop (DeSmith *et al.*, 2018) and a lab-based backdrop (Brunsdon & Comber, 2015). Please consider the books as a resource for your own research outside of class. For the Brunsdon & Comber (2015) book, for example, it is appropriate for you to work through the example-sets on your own, essentially as a way to learn how to apply the lab material in class (which uses the same techniques but often in different ways and environments) to new computational settings and application sets.

De Smith, Michael John; Michael F. Goodchild, and Paul Longley. "*Geospatial analysis: a comprehensive guide to principles, techniques and software tools*". Troubador Publishing Ltd, Sixth Edition, 2018. The book is freely available Online at http://www.spatialanalysisonline.com/HTML/. From time to time, I may also suggest relevant links or other reading material. I will also distribute relevant articles or book chapters to read that are relevant to a particular class topic, with the intent that these will prompt follow-on discussions. Indexed as DGL in the lecture schedule.

Brunsdon, Chris & Comber, Lex. *An Introduction to R for Spatial Analysis and Mapping"*. Sage, Sherman Oaks, CA, 2015. (The code base for *R* has shifted somewhat since the book was released in 2015, so you should consult the book for the correct version of *R*.) Indexed as BL in the lecture schedule.

Some expectations for this course

Students are expected to obtain and read relevant and assigned course material and to take independent initiative to find and read related and relevant material outside items assigned through the course. It is important that this independent research form a component of your graded coursework and in-class discussion, i.e., your projects should not simply restate the course material, you should independently seek to expand upon the foundation that the course material provides. Your independent work for this course may well require that you study and research outside course meeting times using your own initiative and it may require that you work on practical exercises outside course meeting times. Your work in class and potentially in projects may require that you collaborate and debate as part of a group.

Attendance policy

Attendance and in-class participation are an important component of learning the material in this course, keeping up with the concepts as they develop in class, and thinking through the problem-sets we will examine.

Absences from class

Please review the course schedule contained in this syllabus on the first day of class and assess any potential conflicts with your schedule. If you anticipate being absent from class, please notify me as soon as you can. Please consult NYU's University Calendar Policy on Religious Holidays at https://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/university-calendar-policy-on-religious-holidays.html.

Excused absences

Please refer to the CUSP student handbook, Tandon policies, and NYU policy regarding excused absences.

Requests for accommodations because of a disability

I will be happy to work with students that request accommodations because of a disability. Please feel free to discuss this directly with me, or contact the *NYU Moses Center for Students with Disabilities* (https://www.nyu.edu/students/communities-and-groups/students-with-disabilities.html). So that I can make necessary accommodations, it is important that you notify me, or the CSD, of your request as soon as possible.

Use of students' personal computers and other devices in the classroom

My policy is as follows: laptop computers and tablet devices may be used **only for taking notes**.

Conduct in class

You are expected to follow NYU's Student Conduct and Community Standards (https://www.nyu.edu/students/student-information-and-resources/student-community-standards.html). You are expected to follow Tandon's Community Standards and Procedures (https://engineering.nyu.edu/campus-and-community/student-life/office-student-affairs/community-standards-and-procedures).

Research with or involving human subjects

There may be some situations in the course in which use of spatial data or data analyses present human subjects concerns. Please refer to NYU's policy for research with human subjects at https://www.nyu.edu/research/resources-and-support-offices/getting-started-withyourresearch/human-subjects-research.html. Should you have any questions about research (particularly research that you might consider doing as part of your projects) that might involve

human subjects, or that might involve data on human subjects, please let me know of your questions before conducting the work.

Communicating with the instructor outside class hours

Please do not rely on email as a substitute for face-to-face contact. If you do email me, I cannot always guarantee a quick response. Generally, I try to return emails within a week. Email can be an unreliable form of communication. Email messages regularly become trapped in spam filters. I will not reply to your emails in the evening, on the weekend, or over University holidays. Please use your @nyu.edu email address when communicating with me, and check your @nyu.edu email regularly, as this is the most reliable way for me to get in contact with the class outside of class meetings. Please check to ensure that your @nyu.edu mailbox is not full (this may occur even if you have established a forwarding mechanism to another mail provider).

I am generally available to talk with students before and after class; you are always welcome to visit my office hours or make an appointment to meet with me outside of these times.

As a general policy, I do not return phone calls to students at their private numbers. If an urgent matter arises relating to this course, and I am unavailable, you may contact the staff in the Center for Urban Science + Progress for assistance (+1 (646) 997-0500).

Course evaluations

Your course evaluations help me to develop subsequent sections of this course, and others, and I really do welcome your feedback and comments. Please feel free to provide me with these comments at any time, but also please consider using the NYU evaluation systems as they present.

University emergency closing

In the event that the University is closed for an emergency or extended period of time, I will communicate with you via email to indicate schedule adjustments. Office closures and delays are announced on the campus Website at http://www.nyu.edu/.

Recording lecture materials

I do not permit recording of lecture materials by video or audio in the classroom.

Copyright

I retain all copyright to the Powerpoint slides (and any derivative version of them), the course content, coursework and assignment questions, and the lectures.

Academic integrity

Students will be expected to adhere to NYU's Academic Integrity policy: (https://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/academic-integrity-for-students-at-nyu.html), to the academic integrity policy for the

Center for Urban Science + Progress as outlined in the student handbook, and to Tandon's Student Code of Conduct (https://engineering.nyu.edu/campus-and-community/student-life/office-student-affairs/community-standards-and-procedures).

Please take particular care to familiarize yourself with issues surrounding plagiarism and cheating, in all of its forms. Instances of plagiarism on any coursework will be met with a grade of F for the entire course grade.

Final words

We are going to be talking about humans and their use of space and time. This may involve some discussion of conflict, disasters, cultural and social differences, human tragedy, and so on. It is possible that some of the writings, lectures, films, or presentations in this course may include material that some students may find offensive. Please review the syllabus with this in mind; if you have a concern, please discuss it with me at your earliest convenience.

I love teaching this material and I hope will enjoy the course.

Lecture schedule (except for coursework dates, the timing of the lectures and labs may change as we progress quickly/slowly)

Date	**Topic**	**Reading reference**
September 9	Introduction and overview	Syllabus; BL 1,2,3
	Lab: containers for spatial data in ArcGIS	
September 16	Geographical perspectives on data	DGL chapters 2, 3; BL 1,2,3
	Lab: containers for spatial data in ArcGIS	
September 23	Spatial data models	DGL 2, 3; BL 4, 5
	Lab: spatial joins	
September 30	Spatial clustering	DGL 5; BL 6, 7, 8
	Lab: Global spatial autocorrelation	
October 14	Fall recess: no class	
October 15	Legislative day: classes meet on Monday schedule	DGL 5; BL 6, 7, 8
	Lab: Local spatial autocorrelation	

October 21	**Project 1 due**	
	Spatial clustering	DGL 5; BL 6, 7, 8
	Lab: **project presentations**	
October 28	Spatial interpolation	DGL 5; BL 6
	Lab: spatial autocorrelation in R	
November 4	Spatial interpolation	DGL 5; BL 6
	Lab: spatial interpolation	
November 11	Spatial interpolation	DGL 5; BL 6
	Lab: geostatistics	
November 18	Spatial interaction	Chapter 7, journal articles TBD
	Lab: gravity models	
November 25	Spatial regression	Journal articles TBD, BL 7
	Lab: spatially-adjusted regression	
December 2	**Project 2 due**	
	Spatial regression	Journal articles TBD, BL 7
	Lab: **project presentations**	
December 9	Spatial regression	Journal articles TBD, BL 7
	Lab: geographically-weighted regression	
	Course-wide paper due	