But, of course, that view of infinite vision is an illusion, a god trick.1

Course Description

Overview
With the veritable explosion of urban data alongside the continued proliferation of new tools for its consideration, this course allows students to develop specialized approaches to spatial analysis while introducing a series of common advanced techniques and nuanced methodological questions. Aimed at covering a variety of topics with immediate relevance to urbanism in practice and in research, the course operates with a two-fold mission: (1) to critically discuss the theories, concepts, and research methods involved in spatial analysis and (2) to learn the techniques necessary for engaging those theories and deploying those methods. The class will work to meet this mission with a dedicated focus on the urban environment and the spatial particularities and relationships that arise from the urban context.

Among others, this course takes as a foundational premise that spatial analysis is an incredibly powerful and double-edged weapon: it provides both the methods for answering complex spatial questions and the means for effectively communicating the results. Like any other weapon it can serve many ends, and as such an advanced course in spatial analysis must frame its use within the developing discourse on professional practice and responsibility.

Method of Instruction

The course is designed with a hybrid instructional format: project-based seminar. Seminar-style presentation and discussion will rely heavily on student participation and preparation to consider the variety of spatial methods available and their implications on research, design, and planning. Woven throughout the semester is the development of an assignment-driven research project, through which students will engage and compare the methodological advantages and disadvantages of several assumptions, approaches, analyses, and datasets. While certain class meeting sessions are planned for project development and discussion of research design and methods, students are expected to use their projects as additional discussion material throughout the semester.

Lastly, short explanatory lectures are planned for certain topics to aid skills acquisition, our seminar discussions, and the development of the research projects. Toward this, several skills-based tutorials will be made available for students to complete outside of class, along with the seminar readings.

Prerequisites

Students must have successfully completed Geographic Information Systems (PLANA4577) or have similar experience to be eligible to enroll in Advanced Spatial Analysis. Other introductory GIS courses or related professional work will be considered as sufficient experience only with prior approval from LM.

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Student Learning Objectives

Following from the course mission, upon successful completion of the class students will have

- Built upon their familiarity with technical concepts of network analysis, cartographic modeling, decision support, and spatial statistics with more advanced analytical approaches;
- Gained familiarity with the concepts of remote sensing and feature extraction, geostatistics and interpolation, automation in geographic information systems software;
- Accomplished the prior two objectives through urban planning examples such as land use, transportation, environmental quality, accessibility, and public participation;
- Examined the recent history of common analytical approaches to prevalent urban issues, comparing their relative advantages, assumptions, and outcomes;
- Furthered their (carto)graphic communication skills as well as textual and verbal communication skills for specialist as well as lay audiences; and
- Developed critical research design skills and processes.

Standard Information

Class meets in 408 Avery Hall on Wednesdays from 9 to 11AM. Barring any technical difficulties, class will begin promptly.

Device Policy

For the respect of others, the classroom policy on devices and computers is as follows.

- Students may use the computers, tablets, and other digital devices to access readings and notes.
- Students may use those devices for other reasons very minimally, so long as they do not become a distraction or an in-class habit.
- Non-class-related, on-screen content is not allowed. This means that, by way of example, the absolute only way to make Twitter usage okay by this policy is to be tweeting about class (with appropriate hashtags and mentions, of course).

Evaluation & Grading

Seminar Participation (15% of final grade)

As a seminar-structured course, discussion participation is paramount to achieving the class’s learning objectives. Further, our aim here is to jointly learn through individual work and through the projects developed by others. Much of the syllabus’s content is in-development in the literature, under debate, and subject to criticism: “Data science” is arguably still a proto-science; data sources are not created equally; the subjectivities of spatial analysis are numerous; and (for example) there are more than a dozen ways to quantify “access.” Thoughtful and rigorous spatial analysis requires reflection, discussion, debate, and critique. In other words: We will all learn in direct proportion to what we all contribute to our seminar.

Students are expected to keep up with the syllabus schedule, completing readings prior to class and arriving prepared for discussion. Notes will be kept regarding student involvement for each class session.

Given the material covered in the course and the skills-development value of collaborative troubleshooting, it is only appropriate to include digital platforms when evaluating “active participation.” The class’s Canvas discussion board (see below) will be used for augmenting in-class discussion. For the social-media inclined, use the hashtag #gsappGIS for participation credit.

Topical Presentation & Bibliography (25% of the final grade)

Each student (working in groups) will deliver one in-class presentation, supplemented with an annotated bibliography, together comprising a critical, thoughtful synopsis and synthesis of a methodological problem and/or emerging toolsets. Presentations will be scheduled throughout the semester, following the course schedule. A detailed assignment description will be distributed online. Students are strongly encouraged to meet with LM before developing the content for their presentation.

Research Project (60% of)

Students are expected to design, research, and complete a self-directed final project on a topic of their choosing through the course of the semester. The project is required to answer
and/or explore a specifically spatial research question and must compare techniques and approaches of analysis in its methodology. Final deliverables should be completed in groups, although early assignments may be completed individually.

A full assignment description—detailing expectations, deliverables, guidelines, and considerations—will be distributed online at the beginning of the semester. Briefly, students will be required to submit several deliverables, including a topic paragraph, methodology statement, graphic drafts, final report, and poster.

**Attendance**

Students are expected to attend every class meeting. Attendance records will be maintained throughout the semester (via sign-in sheets). Students with excessive absences (greater than 1) without appropriate reason will see a reduction in their final grades.

Students who will miss class due to religious holidays or other appropriate reason should email LM and the class TA in the first week of classes with the dates (and reasons) of their foreseen absences and are encouraged to make arrangements with their peers for notes.

**Submission**

Each assignment will outline the specific requirements for its submission format, deadline, and deliverable expectations. Be advised that some assignments may require online submission, hard-copy submission, or both.

Save for extenuating circumstances for which extensions will be given only with prior approval and compelling reasons, absolutely no late assignments will be accepted without a late penalty. The late penalty is a reduction of 50% of the total points possible within the first 24 hours after the deadline and an additional 25% of the total possible points up to 48 hours after the deadline.

**Back-up Policy**

Students are responsible for consistently backing up their work throughout the semester. Extensions will not be granted for technical losses of work. (Given the availability of cloud storage and the need to regularly store one’s work off GSAPP machines, this should never be a problem in the course.)

**Grades**

Students are often concerned with where the lines are drawn in determining final grades. To avoid confusion or panic, here’s how it will work: LM will use the percentages listed above to assign grades at the end of the semester. High-quality projects and deliverables are expected for receiving a Pass (and necessary but insufficient for receiving a High Pass). The High Pass is reserved for truly outstanding, consistent, and dedicated work in all aspects of the course, including seminar preparation and discussion.

**Expectation of Academic Honesty**

As always and as with every other course, this class is conducted in accordance with University policy on matters of academic honesty and integrity and with attention to the University’s Honor Code. Note that instances of plagiarism will not be tolerated—whether in written text, in research design, or in data acquisition and creation—and will result in an automatic failure in the course. We build on the work of others; give credit where credit is due.

Additionally, this course contains a few considerations which should be stated. At several points in the semester, students will be encouraged to look to their peers for collaborative problem solving and troubleshooting especially within the lab setting. Except where otherwise stated in specific assignments, collaboration is welcomed but individual assignments must be conceived and completed individually.

**Students with Disabilities**

Students with disabilities taking this course who may need disability-related accommodations are encouraged to make an appointment with LM and their lab instructor as soon as possible. Disabled students who need accommodations should be registered in advance with the Office of Disability Services.

**Resources & Materials**

**This Syllabus**

This syllabus is a map. It is designed as students’ first, go-to resource for navigating and managing this course. It includes guidance on almost every common, foreseeable question
students might have. In some cases, the syllabus provides the answer. In most cases, the syllabus offers suggestions regarding where answers can be found. Students are strongly urged to read the full syllabus (at least once) at the beginning of the semester. Familiarity with the full schedule—knowing the arc of the topics and their relationship to each other—will greatly benefit the development of each deliverable as well as seminar discussion.

**Software & Hardware**

Spatial analysis requires a geographic information system, a required component of which is GIS software. As an industry standard that is also available on all GSAPP computers, most of the tutorials will rely on ESRI’s ArcGIS suite of software. Single-use educational licenses will be given to students in the class for their use on their personal machines (Windows OS only). To request a license, notify the TA during the first week of class.

An Important Note: The course’s objective is not to create experts in using ESRI software, and there are certainly a variety of other GIS software packages available. Students interested in developing facility with QGIS, spatial analysis in R or Python, or GIS applications developed for specialized analyses, are very much encouraged to do so. Resources for self-directed learning are listed throughout the syllabus.

**Recommended Purchases**

There are no required reading purchases associated with the course. All required reading materials not accessible online or via the University Libraries will be made available as PDFs and distributed through Canvas. That said, there are several excellent additional resources (books, etc) mentioned throughout the schedule recommended for students interested in further developing particular skills.

Students are encouraged to have an external hard drive with a minimum capacity of 20GB available or comparable accessible cloud storage for their files related to this class.

**Canvas**

This class relies on the Canvas platform for distributing readings (only those not available through the university libraries website), collecting and sharing additional resources, submitting digital copies of assignment deliverables, and discussion. Canvas will also be used to distribute class-wide emails. Please be sure to actively monitor the email address associated with your Canvas login.

If you have a question, it is likely that your peers may be presently working out the same issue or may have already found a solution. Students are encouraged to post questions and relevant points for conversation to the discussion board on Canvas and collectively work toward finding answers prior to emailing LM or the TA. Spatial analysis is a techniques-heavy endeavor with several moments that require developing critical problem-solving skills. These skills are substantially and demonstrably better acquired when the solutions are derived through work than through asking your TA.

As an incentive toward using the discussion board, the TA will participate in the online discussion (where necessary) on a (minimum) weekly basis.

**DSSC**

The Digital Service Science Center is located on the lower level of Lehman Library (at SIPA) and is a great resource for GIS data and technical questions. DSSC collects spatial data and may have what you need for your final project. Further, if they don’t have the data you’re looking for, the data librarians can usually help you find it. DSSC also has technical consultants available for questions regarding data as well as those related to performing certain GIS operations. Their facility is equipped with computer stations (with extremely nice monitors). Check their hours of operation before visiting on the Columbia Libraries website. 
http://library.columbia.edu/content/libraryweb/indiv/dssc.html

**Course Tutorials**

Because techniques of spatial analysis require the development of computer-based skills, their adequate teaching and learning likewise require completing skills-oriented tutorials and exercises. The software-related skills highlighted by class tutorials are broad, designed to cover concepts important for all students. Like the readings, these tutorials are neither required nor optional. It is expected that all students will complete the tutorials in their own time, keeping pace with the schedule of seminar topics or skipping ahead to learn the skills most relevant to their research projects.
Students are encouraged to develop specific additional and relevant skills using all means available to them. There are, of course, several tutorials available online. These include the University’s Lynda subscription (available through the libraries website) as well as user forums and software-specific websites. That said, please use online tutorials discriminatingly. They vary in quality, and students are better served by evaluating several before choosing one.

**TA**

Kenneth Warner (kcw2145@columbia.edu) is the course teaching assistant. He is available for technical assistance as well as for discussion of other class-related questions and concerns. In addition to lab hours and email assistance, the class TA will regularly monitor the class discussion board on Canvas.

**Office & Lab Hours**

LM holds weekly office hours in 303 Buell Hall on Wednesdays from 12:00PM to 1:00PM and by appointment. Toward the end of the semester, additional office and/or lab hours will be scheduled to discuss course progress and final project development.

The class TA will also hold weekly lab hours in the UP computer lab (200N Fayerweather). TA lab hours will be announced during the first week of class. Students are encouraged to use these lab hours as working sessions to take advantage of the available guidance. Of course, individual meetings can be arranged via email for times outside office hours by appointment.

**Notes on Email**

Do not expect immediate responses from LM or the TA to emailed questions. It is very important (especially during “crunch times”) that you use the other resources available to you. There are several ways to find help if you need it, so please do not let an unanswered email hold you back. One of the greatest assets you will have in this course is your own time management. Use lab time and office hours wisely.

If you email a technical question, be sure to include enough information to receive an adequate and helpful response. Necessary information includes, but is not limited to,

- a complete description of what you are trying to accomplish and the problem you are encountering,
- any relevant information regarding the datasets you are using,
- the steps you have already taken to address your problem (so we don’t tell you to do what you’ve already done), and
- any necessary screenshots to help us understand what you are doing when we cannot sit with you in front of a computer.

Do not be surprised if an email without this information is returned to you asking for elaboration.

**Course Schedule**

The requirements for the readings and tutorials are flexible only insofar as students’ backgrounds and research interests vary. Note that the readings and tutorials listed below are neither required nor optional. The requirement for each class session is arriving prepared for active participation in discussion. This includes (but is not limited to) reading the necessary materials, preparing notes and questions, familiarizing yourself with the relevant skills presented in the tutorials, and thoughtfully and carefully considering the discussion notes provided in the schedule below. To help, most sessions are annotated with topics, prompts, and other guidance to help students approach the readings and prepare for class.

All tutorials for the semester will be made available online in the early weeks of the semester. Students are also encouraged to seek out other skills-developing resources (some of which are listed above), as necessary.

Lastly, the deadlines provided in the semester schedule below include abbreviated description. Refer to the full assignment descriptions for detailed instructions and expectations for each deliverable.
An Extra Note on the Readings

There is no shortage of material on techniques, concepts, and debates concerning spatial analysis, with new research and new tools evolving constantly. One semester neither can nor should cover the full breadth of advanced skills and topics one might encounter in the literature. Instead, care has been taken to include necessary and/or representative readings, with a mind toward the specialized and self-directed readings expected from each student.

How to approach the readings: Whether textbook chapters or research articles, students should approach the readings critically with attention to the mission, aims, and objectives of the course. For each reading list, students should ask themselves why these sources have been chosen, in search of commonalities and differences. Some offer technical background, terminology, and concepts. Others describe the historical trajectory of techniques or the development of (and reaction to) computer-based techniques of spatial thinking and evaluation. There are several references that contain and require quantitative fluency for full comprehension, while others ask you to read through software exercises or tutorials (that might not be assigned in the class). In all cases, again, students should ask themselves what is crucial for meaningful discussion and what is not.

We know that “doing” is the only one way to learn introductory GIS skills. Similarly, there is only one way to develop advanced, sophisticated, and nuanced approaches to spatial analysis: read.

Week 1
23 Jan

INTRODUCTIONS
The first week’s plan includes a review of the syllabus, the scope and expectations of the course, and a discussion on spatial methods and methodologies. The full description of the Class Presentation assignment will be distributed online prior to the start of class.

Refresher Readings. The readings listed below were each assigned in the PLAN A4577 Geographic Information Systems course. Review these as necessary for an engaged discussion. Students are encouraged (indeed, expected) to refer to the readings from earlier and other courses as they apply to our discussions throughout the semester.


Weeks 2-3
THE PROMISE & THE TROUBLE
These early weeks of the semester include topics and establish premises to which we will refer for the remainder of the course. These readings should serve as a basis for our discussions, and students are expected to return to them as relevant to our later topics.

30 Jan
Quickness: Automation and Algorithms
Class Plan: Seminar Presentation followed by discussion.

Research Project. Full assignment description will be distributed online before the start of class. Review the material and arrive with questions.

Tutorials. Students are advised to complete the ModelBuilder Automation tutorial before or shortly after this class session. The Brunsdon and Comber (2016) and Zandbergen (2013) references (listed in the Syllabus Appendix) are also helpful here.
Problems, Positions, and Opportunities for Digital Urban Analysis. These papers summarize recent (and less recent) arguments on the role of computational modeling and analysis in urban research and practice.


Textbook Resources


6 Feb

**Bigness: Social Data, Crowds, and Ubiquity**

Class plan: Seminar Presentation followed by discussion.

Research Project. Topic Paragraphs are due via the Canvas Discussion Board by the start of class. Post one submission per group (postings should include all group members’ names).

Big, Social Data, Mapping, and the City. The papers by Lee et al (2015), Li et al (2016), Sui and Goodchild (2011), and Tsou (2015), each address big-picture questions raised by the relationship between GIS and big (and/or social media-based) data. The others (Huang and Wong, 2016; Shelton et al, 2015; Shelton, 2017; and van Meeteren and Poorthuis, 2018) pertain specifically to the use of these data types and sources in urban research.


(Just Some) Examples in Application. These are a small sampling of recent studies deploying social media data to investigate specific urban questions.


**Crowdsourcing and Counterpoints.** Big, social data in urban spatial research is not a substitute for qualitative or participatory GIS. Dodge and Kitchin (2013) and Voigt et al (2016) discuss some of the pertinent points raised by crowdsourcing and volunteered geodata. The Steinberg and Steinberg (2010) textbook chapters serve as a reminder and refresher. Lastly, the Johnson et al (2017) paper touches upon an ancillary movement in the push toward social(izing) geodata: open data.


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Week 4

**RESEARCH**

Throughout the semester, class sessions are reserved for discussions on research design. Unless specifically noted, these are not “working sessions” or “desk crits.” Rather, students should prepare for discussion as they would any other week: reviewing the relevant readings, progressing with their independent research projects, and assembling discussion points and questions pertinent to the day’s discussion. Of course, because each project is different, the “pertinent” materials will vary from student to student. The aim is a lively, thoughtful, and comparative discussion of the choices made by researchers using techniques of spatial analysis across the many topics covered by the projects in the class.

The course’s “Research Weeks” have little to no readings associated with them. In addition to developing their projects and preparing for class, students are encouraged to use this time to catch up with the course tutorials.

13 Feb

**Research Questions, Data Sets, and Choosing Methods**

**Class Plan:** Brief lecture on cartographic modeling and spatial research design, followed by discussion and workshopping of proposed project topics.

**Research Project.** Peer feedback on Topic Paragraphs is due by the start of class, submitted by commenting on the Canvas discussion board.


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Weeks 5-8

**NOT-SO-STANDARD CONCEPTS**

The central weeks of the semester are devoted to rather standard urban analysis concepts with remarkably unstandardized methods or measurements. Indeed, each of these topics is commonly discussed, evaluated, compared in planning and design. That said, the means by
which they are measured, approximated, or operationalized can vary widely or (worse) be taken for granted. Consider: The data sets and calculations we use to measure urban growth do not indicate decline when results include negative values. Or: Why would we quantify the segregation of individuals and the mixture of land uses with the same methods? These are not easy questions, but we will attempt to unpack them.

The reading lists for these central weeks are lengthy. Again: None of them are required, but none of them are optional. Most are short research papers (and excellent examples of formatting such a study). Read through their abstracts, methodologies, and conclusions (at a minimum). Remember: most are assembled for comparison and discussion, while others are references and resources for you to have.

20 Feb

Feasibility and Impact
Class Plan: Seminar Presentation followed by discussion.

Research Project. Questions and Datasets are due by the start of class, via the Canvas discussion board.

Feasibility, Suitability, and Impact. These studies offer examples of modeling projects and approaches on a variety of urban and planning-related topics. NOTE: In addition to their contributions to the topic, the Gontier et al (2010) and Terrapon-Pfaff et al (2017) articles provide examples of papers predicated on comparing methods.


Contextualizing Techniques. These readings do not explicitly discuss techniques of data-driven or GIS-based spatial analysis, but frame and discuss the difficulties involved in modeling feasibility and impact. (They mostly focus on the design of impact assessment studies.)

Textbook Resources. The Malczewski and Rinner (2015) text is an excellent resource for students interested in GIS-MCDA, whether for feasibility and suitability modeling, as an added component to impact assessment studies, or a tool to enable participatory practices. It is referenced in the Appendix and available as an ebook from the university’s libraries.

27 Feb

Access and Accessibility
Class Plan: Seminar presentation followed by discussion.

Tutorials: Students are advised to complete the Networks tutorials before or shortly after this class session.

Research Project. Peer feedback on Questions and Datasets is due by the start of class, submitted as comments on the Canvas discussion board.

Measuring Access, the foundations: These readings cover and compare methods of quantifying or otherwise describing levels of accessibility and/or the impacts of these methods on describing other urban and spatial structure. Several of these papers also serve as models for designing and writing methodologically comparative papers. The older articles (Black and Conroy, 1977; Koenig, 1975; Pirie, 1979) lay important conceptual groundwork, and Boschmann (2011) provides an importantly qualitative counterpoint.


Accessibility Metrics in Application: These readings are just a few examples of accessibility-related studies, applying measurements to urban questions. The aim of this list is clearly not an exhaustive or, even, representative survey of topics or types of analysis, but to offer a brief set of illustrative examples expanding on the topics covered above.


Key Geographical Concepts, for your reference: This list focuses less on “access” per se and more on the key spatial, geographical, and mathematical concepts behind the difficulty in assessing accessibility. Primary among them are the questions of distance decay and aggregation, which has a long history of analysis.


Further Resources on Network Analysis: Spatial analysis of accessibility necessarily requires advanced techniques working with spatial network data (including multimodal network datasets). These are texts for practical guidance.


**6 March**

**Growth and Decline**

Class Plan. Seminar presentation followed by discussion.

Research Project. Precedent Bibliography is due by the start of class via the Canvas discussion board.

Methodologies for measuring Land Change: These readings provide some examples of the ways in which the spatial analysis of urban shrinkage is not the opposite of analyzing urban growth (and vice versa). Indeed, their conceptualizations are quite different, and thus the techniques involved are varied.


**Case Studies**


Textbook References on Remote Sensing and Feature Recognition


Campbell, J B and Wynne R H. (2011). Introduction to Remote Sensing. New York: Guilford Press. (Chapters 1, 8, 12, 14, 16, 20, and 21). NOTE: I do not expect you to perform a close read of all of these chapters prior to class. I do expect that students will familiarize themselves with the concepts, techniques, and applications of remote sensing covered in these chapters in preparation for discussion.

13 March

Mixture and Segregation

Class Plan: Seminar presentation followed by discussion.

Research Project. Methodology Statement is due by 11:59PM on Friday, 15 March, via the Canvas Assignment Submission form.

Methodologies for Measuring Spatial Arrangement: These readings comprise examples of the ways in which the spatial arrangement of entities relative to one another are measured and described. Many of the most common techniques are surprisingly nonspatial (save for aggregation), while others conceptualize arrangement via spatial relationships (Distance + 4Cs). Through this weeks’ readings, most of the readings collected will describe the mixing or segregation of either demographics or land uses.


Just a few Case Studies (Methods and Indices in Application):


Weeks 9-11

RESEARCH
OK. Breathe. We just plowed through four weeks of very rich topics with a dizzying array of methods and a potentially unsettling level of conflict regarding exactly how spatial phenomena are described and how urban outcomes are measured. The next few weeks are an opportunity to regroup and apply the critical approaches we have discussed and compared to your own work. Now is the time to take the methodological, conceptual, and operational questions we have used to interrogate the readings and ask them of your research projects.

20 March

Spring Break: No Class

27 March

Comparing Methodologies
Class Plan: Workshopping research project methodology comparisons. To prepare, students should have preliminary findings from at least two analyses, sufficient to discuss the basis for comparing results from different methods and approaches.

3 April

Communicating Findings
Class Plan: TA presentation of deliverable examples (the good, the bad, and the ugly) and project workshopping. (LM will be away this week. Use this class period to workshop and receive feedback on project development.)

Weeks 12-13

THE QUANTITATIVE QUESTIONS
The topics covered thus far in the semester include approaches that range from the qualitative to the geometric to the statistical. They are gathered by substantive focus rather than the particularities and intricacies of specific methods. In contrast, these final weeks of the seminar will add to our conversations by diving deeper into two categories of advanced quantitative spatial analysis: spatial statistics and geostatistics, both of which were conceptually introduced in the (core) Geographic Information Systems course.

The readings lists for these two weeks are short, as students are encouraged to give most of their time during these weeks to the development of their research projects. That said, additional references (including several examples of these methods in application) can be found in the Appendix.

NOTES: Students interested in advanced statistical techniques are encouraged to consult this section of the syllabus early in the semester, as they prepare the scope of their research projects.

10 April

Clustering and Dispersion
Class Plan: Brief lecture on spatial statistics, including geographically weighted regressions; and Seminar Presentation with class discussion as time allows.
Research Project. Cartography, Graphics, and Layout Drafts are due by the start of class, via the Canvas Discussion Board.

Spatial Statistics in Urban Research: These are a few noteworthy (and often comparative) studies employing spatial statistics on common research topics. If you read only two closely, the Paez and Scott (2004) is a worthwhile overview and Austin, et al's (2005) study is particularly elegant. With respect to the Holt (2007) paper, please be sure to also read the short and important letter to the journal’s editor (Buttery 2008) that followed it.


Textbook References:


17 April

**Estimation and Prediction**

Class Plan: Brief lecture on geostatistics, including kriging; Seminar Presentation with class discussion as time allows.

Research Project. Peer feedback on Cartography, Graphics, and Layout Drafts are due by the start of class, submitted as comments to the Canvas discussion board.

Tutorials: Students are encouraged to complete the geostatistics tutorial shortly after this class.

Geostatistics in Urban Research:


Textbook References: The Demers (2017) chapter offers an accessible overview of interpolation and other techniques of surface analysis. Olea’s (2009) report from the USGS is a very valuable reference, with quickly searchable material on much of the math behind geostatistics.


**Weeks 14-15**

**RESEARCH**

**24 April**

**(Defensible) Conclusions**

*Class Plan:* Concluding seminar discussion on the methodological questions raised during the semester; discussion and workshop final research deliverables as time allows.

**1 May**

**Poster Session and Wrapping Up**

*Class Plan:* Research Project Poster Session (with invited guests).

*Research Project:* Poster PDFs are due via Canvas by the start of class. Final report deliverables are due by 10AM on Monday, 6 May (submitted via Canvas).

**Appendix**

The following are additional readings (loosely organized by topic) that may be of value to students while preparing their topical presentations or research projects.

**GIS-MCDA**


**Environmental Impact Assessment**


**Specifically Quantitative Case Studies**


**More Case Studies**


**Modeling Urban Phenomena**


**Tools & Skills**


