GEO 344: Geographic Information Systems III
Spring 2010-2011 | DePaul University | Department of Geography

1. Meeting
Time: Mon/Wed 1:00-2:30 pm
Location: SAC 224 (GIS Lab) in LPC

2. Instructors

<table>
<thead>
<tr>
<th>Sungsoon (Julie) Hwang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact: <a href="mailto:shwang9@depaul.edu">shwang9@depaul.edu</a>, (773) 325-8668</td>
</tr>
<tr>
<td>Office: Room# 4513, 990 W Fullerton Ave, LPC</td>
</tr>
<tr>
<td>Office hour: Tue/Thur 1-2 pm or by appointment</td>
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<table>
<thead>
<tr>
<th>TBA (Lab assistant)</th>
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<tr>
<td>Contact: TBA</td>
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<td>Lab hour: To be announced weekly via an email</td>
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3. Course Description
GEO 344 is an advanced-level GIS course. Students conduct spatial analysis of sustainability issues of their interests. Topics include geographic visualization, network analysis, spatial interpolation, and exploratory spatial data analysis. Instruction is accomplished through lectures and hands-on computer lab exercises using ArcGIS. This course is formerly known as GEO 244. Prerequisite(s): GEO 242 or consent of instructor.

The purpose of GEO 344 is to learn concepts and techniques for analyzing spatial pattern, interaction and relationship as a means to gain a better understanding of geographic processes involved in sustainability of the planet earth in a GIS environment.

4. Learning Goals
- Understand concepts and techniques related to exploring spatial pattern from various spatial data types, including exploratory spatial data analysis (ESDA), stochastic methods of spatial interpolation, and point pattern analysis
- Understand concepts and techniques related to analyzing spatial interaction, including network analysis and hydrological modeling
- Understand concepts and techniques related to analyzing spatial relationship, including spatial overlay analysis, proximity analysis, and regression
- Understand concepts and techniques related to mapping change over time, including change mapping, temporal overlay analysis, and animation
- Discern the utility of GIS in advancing sustainability

5. Learning Outcomes
- Determine GIS techniques for analyzing spatial pattern appropriate for a given geographic problem, and conduct spatial pattern analysis
- Determine GIS techniques for analyzing spatial interaction appropriate for a given geographic problem, and conduct spatial interaction analysis
- Choose GIS techniques for analyzing spatial relationship appropriate for a given geographic problem, and conduct spatial relationship analysis
- Choose GIS techniques for analyzing change appropriate for a given geographic problem, and conduct change analysis
- Conduct geographic analysis for sustainability research
6. Course Text(s)
There is no text to buy. Required readings are posted as PDF files on the D2L.

7. Outlines of Topics & Tentative Schedules

<table>
<thead>
<tr>
<th>Wk</th>
<th>Date</th>
<th>Topics</th>
<th>Labs</th>
<th>Article summary</th>
<th>Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3/28</td>
<td>Course overview</td>
<td></td>
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<tr>
<td></td>
<td>3/30</td>
<td><strong>Framework of Spatial Analysis for Sustainability</strong></td>
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Part I. Analyzing spatial pattern

| 2  | 4/4  | **Exploratory Spatial Data Analysis** | 1. ESDA |
|    | 4/6  | Origins of the sustainability concept | 1. ESDA | Article |
| 3  | 4/11 | **Spatial Interpolation** | 2. SI |
|    | 4/13 | Theories of sustainability | 2. SI | 1, 2, 3 |
| 4  | 4/18 | **Point Pattern Analysis** | 3. PPA | 4, 5 |
|    | 4/20 | Indicators of sustainability | 3. PPA | 6, 7, 8 |
| 5  | 4/25 | Test1 |      |       |

Part II. Analyzing interconnection

| 6  | 4/27 | **Analyzing Spatial Interaction** | 4. SIA | 9, 10 |
| 7  | 5/2  | Indicators of sustainability | 4. SIA | 11, 12 |
| 8  | 5/11 | **Analyzing Spatial Relationship** | 5. SRA | 13, 14 |
| 9  | 5/9  | **Analyzing Changes** | 5. SRA | 15, 16, 17, 18 Proposal |
|    | 5/16 | Test2 |      |       |

Part III. Geospatial analysis of sustainability

| 10 | 5/23 | Paper help |      | Data |
|    | 5/25 | Paper help |      |       |
|    | 5/30 | Paper help |      |       |
|    | 6/1  | Paper help |      |       |
| 11 | 6/6  | Paper due 2 pm on D2L dropbox |      | Paper |

8. Grading Scheme

<table>
<thead>
<tr>
<th>Grading Breakdown</th>
<th>Grading Scale</th>
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<tbody>
<tr>
<td>Participation</td>
<td>15 %</td>
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<tr>
<td>6 labs (each 3 pts)</td>
<td>18 %</td>
</tr>
<tr>
<td>2 tests (each 15 pts)</td>
<td>30 %</td>
</tr>
<tr>
<td>Paper (proposal 2, data 2, paper 28)</td>
<td>32 %</td>
</tr>
<tr>
<td>Article summary</td>
<td>5 %</td>
</tr>
</tbody>
</table>

A = 93-100%  C+ = 77-79.99%
A- = 90-92.99%  C = 73-76.99%
B+ = 87-89.99%  C- = 70-72.99%
B = 83-86.99%  D+ = 60-69.99%
B- = 80-82.99%  D = 50-59.99%
F = 0-49.99%

8.1 Participation
“Do you participate in the classroom sessions actively?” This may include paying attention to lectures, raising right questions, and contributing to classroom discussions. Read (learn from the authority, not from me) before the class!
8.2 Labs
“Can you conduct advanced-level geospatial analysis for exploring spatial pattern, interaction, and relationship in ArcGIS?” With labs, you will learn advanced-level skills to use ArcInfo 10 on the following topics:

Lab1: ESDA techniques for exploring demographic characteristics of population from aggregate data (such as census), including
- Graphs linked to maps
- Chart maps
- Local spatial autocorrelation maps—Anselin Local Morans I, Getis-Ord Gi*

Lab2: spatial interpolation techniques for mapping (or estimating) ozone level, including
- Local polynomial (spline): local surface fitting techniques
- Inverse distance weighting: local moving average techniques
- Ordinary Kriging: geostatistical (stochastic) techniques

Lab3: techniques for exploring spatial pattern of bicycle crashes, including
- Quadrat analysis: tabulates density per unit area
- Nearest neighbor analysis: determines spatial clustering at a local scale
- K function: determines spatial clustering at multiple scales

Lab4: techniques for measuring (or modeling) spatial interaction (or the least cost path) on transportation network and terrain surface, including
- Market (service) area analysis: delineates service area from network dataset
- Flow (OD cost matrix) analysis: analyzes flow between origins and destinations
- Hydrological modeling: delineates stream order and sub-water basin from DEM

Lab5: techniques for analyzing spatial relationship between variables, including
- Spatial overlay analysis: combines disparate data layers
- Proximity analysis: measures distance between origins and destinations
- Multivariate statistics: conducts correlation & regression analysis

Lab6: techniques for mapping change, including
- Change mapping: maps change values
- Temporal overlay analysis: delineates areas that have changed given a period
- Animation: animates spatial variation of values of a variable over time

Labs will be completed individually in class when instructors are present under most circumstances. If you can’t complete the lab in time, make arrangement with a lab assistant.

8.3 Tests
“Can you describe methods of spatial analysis covered in the class, and conduct the analysis in ArcGIS competently?”

Test1 covers the first three modules, that is exploratory spatial data analysis, spatial interpolation, and point pattern analysis. Test2 covers the second three modules, that is methods for analyzing spatial interaction, spatial relationship, and changes. Tests have the written and practical part which tests relevant knowledge and skills, respectively.
8.4 Paper
“Can you synthesize and apply GIS concepts and methods, as well as the notion of sustainability in conducting empirical research for the purpose of elucidating issues related to sustainability?”

What does it count as sustainability research?
“Sustainability research focuses on a key principle of sustainability (such as social equity or environmental stewardship); addresses a sustainability challenge (such as climate change or poverty); or further our understanding of the interconnectedness of societal and environmental challenges. Sustainability research leads toward solutions that support economic prosperity, social well-being, and ecological health.”—Definition of sustainability research adopted by numerous universities submitted to AASHE (Association for the Advancement of Sustainability in Higher Education) STARS.

What are minimum requirements of GEO344 paper?
The GEO344 paper should
- Be an empirical paper
  o What’s good: collect and analyze data
  o What’s NOT good: literature review only, conceptual paper
- Demonstrate advanced-level GIS knowledge
  o What’s good: use techniques learned from GEO344
  o What’s NOT good: use techniques learned from lower-level GIS courses
- Be related to sustainability (unless excused*)
  o What’s good: contexts or motivations of the study is informed by sustainability discourse, or uses sustainability theory, or uses sustainability indicators
  o What’s NOT good: has no bearing on sustainability
*You can be waived on a sustainability requirement if you provide a good reason.

How will the paper be evaluated?
The paper will be graded, based on the following rubrics:
- How well minimum requirements are met (20%)
  o Empirical (6%)
  o Advanced GIS (10%)
  o Sustainability (4%) unless excused
- Substance (50%)
  o Arguments are well developed in introduction (10%)
  o Methods are appropriate for a problem (20%)
  o Methods are executed without errors (5%)
  o Results are accurate and well presented (5%)
  o Conclusions are drawn logically (10%)
- Style (30%)
  o Ideas are well organized and clearly expressed (20%)
  o Necessary sections are present and properly titled (10%)

8.5 Article summary
Pick one article related to the topic of your paper, and present the summary of an article on the date scheduled (this is likely to be assigned). You will be given about 10 minutes for presentation, and you are required to submit a one-page summary report before the presentation. Submit the citation of an article you would like to present by April 6th to an
instructor. The list of relevant bibliography is provided, from which you may choose an article. The goal is to learn from each other, and stimulate thoughts for sustainability research. The article should be of credible sources (such as scientific journal articles, chapters of book written by experts). Sources like newspaper articles are not likely to be accepted.

**Late Work Policy:** Late labs can be accepted with the deduction of 10% of the grade per day being late. For instance, if you turn in Labs 10 days after due dates, no points will be granted. All other assignments (paper, and article summary) should be submitted as scheduled unless an extension is given by an instructor.

**Makeup Exam/Incomplete Grade Policy:** A makeup exam or an incomplete grade can be arranged or granted only when credible dire and documented medical or family situations arise and these circumstances are communicated in a timely fashion.

**Attendance/Absentee Policy:** Consistent with university’s policy, all students are expected to attend class meetings. Unless absence is explained on medical or compassionate grounds (documentation is required), absence from any classes is grounds for a grade adjustment.

9. Readings & Learning Objectives by Class


- Get familiar with topics of geographic research, and organize them into three subheadings, that is integration in place, interdependencies between places, and interdependencies among scales
- Define the term sustainable development (or sustainability)
- Discuss geographic perspectives (or concepts) that may contribute to scientific understanding of sustainability
- Describe framework for spatial analysis of sustainability

**[4/4] Exploring Spatial Pattern of Aggregate Lattice Data**


- Describe distinguishing characteristics of E(S)DA
- Explain the concept of spatial autocorrelation, and describe how spatial autocorrelation is measured
- Describe methods of constructing spatial weights matrix
- Describe different techniques of ESDA—linking graphs to maps, chart maps, Anselin’s local Moran’s I map, and Getis-Ord’s Gi*
• Conduct ESDA techniques using ArcGIS, including linking graphs to maps, chart maps, Anselin’s local Moran’s I map, and Getis-Ord’s Gi* (Lab1)

[4/6] Origins of the Sustainability Concept


• Reflect on scales of human perspectives on world problems
• Discuss characteristics, utility, and limitations of model
• Is the motto “grow forever” sustainable?
• What is meant by a “steady-state economy”, why is it necessary, and how can it be attained?
• Describe how discourses on sustainable development have evolved, and discuss why sustainable development is seen as a contested concept

[4/11] Exploring Spatial Pattern of Continuous Fields Data


• Describe three elements of semivariogram model—sill, range, and nugget
• Describe how Kriging determines parameters, such as weights
• Compare and contrast IDW, splines, and ordinary Kriging
• Discuss how to validate and improve accuracy of spatial interpolation
• Conduct spatial interpolation in ArcGIS, including IDW, splines, and ordinary Kriging (Lab2)

[4/13] Theories of Sustainability


• Compare and contrast terms economic growth, economic development, and sustainable development
• Describe the notion of capital, and discuss how the notion has evolved in regard to theories of sustainable development (or sustainability)
• Compare and contrast ecological economics theory vs. environmental economics theory on sustainability

[4/18] Exploring Spatial Pattern of Discrete Objects/Events Data

• Describe quadrat analysis
• Describe nearest neighbor analysis (NNA)
• Describe K function
• Discuss relative strengths and weaknesses of different techniques for point pattern analysis, including quadrat, NNA, KDE, and K function
• Conduct point pattern analysis in ArcGIS, including nearest neighbor analysis, kernel density estimation, and K function (Lab3)

[4/20] Indicators of Sustainability


• Describe CSD indicators of sustainable development, including the way in which indicators are organized, as well as examples
• Describe different indicator frameworks, such as DSR, issue- or theme-based, capital, and accounting framework

[4/25] Test1


• Describe the concept of network data model, service area, and OD matrix
• Describe spatial components in hydrologic modeling
• Conduct network analysis in ArcGIS, including service area analysis and flow analysis (Lab4)
• Conduct hydrological modeling in ArcGIS, including stream order and waterbasin delineation (Lab4)

[5/2] Indicators of Sustainability


• Describe four components of Daly Triangle, that is natural capital, built/human capital, human/social capital, and well-being
• Take examples of sustainability indicators for each component of Daly Triangle
• Define sustainability using capital frameworks


- Describe overlay analysis
- Describe proximity analysis
- Describe correlation coefficient
- Describe regression analysis
- Describe geographically weighted regression
- Conduct spatial relationship analysis in ArcGIS, including map algebra (zonal statistics), proximity analysis (near, point distance), and geographically weighted regression (Lab5)


- Describe how time is represented in GIS database
- Describe different techniques for analyzing temporal relationship, including change mapping, temporal overlay analysis, and animation
- Conduct temporal relationship analysis in ArcGIS, including map algebra (raster calculator), and animation (Lab6)

[5/18] Test2

[6/6] Paper due

10. Miscellaneous

Academic Honesty and Plagiarism: Academic honesty and integrity are expected at all times. Academic dishonesty, such as cheating or copying during exams, will be punished severely. Plagiarism – using someone else’s work without acknowledgment and, therefore, presenting their ideas or quotations as your own work – is strictly forbidden. DePaul University officials will be informed of any instance of academic dishonesty and notification will be placed in your file. Please read the DePaul Academic Integrity Resources page (http://academicintegrity.depaul.edu/Resources/index.html) for definitions and explanations of plagiarism and the University’s Academic Integrity expectations for students. Cutting and pasting text taken directly from a web-site without appropriate referencing and quotation marks is plagiarism and is forbidden. Submitting work that has any part cut and pasted directly from the internet is grounds for an automatic grade of zero.

Accommodations: Any student who requires assistance is asked to contact the University’s Office of Students with Disabilities (Phone 773/325-1677, TTY 773/325-7296, Fax 773/325-7396, http://studentaffairs.depaul.edu/studentswithdisabilities. They
will be able to assist both student and faculty. If you have a condition that requires accommodation from the Productive Learning Strategies program (PLuS Program) please contact them at the Student Center room 370 (Phone 773/3251677 or online: http://studentaffairs.depaul.edu/plus/)

**University Center for Writing-Based Learning**: Collaborates with writers from all disciplines, backgrounds, levels of expertise, and roles within the University community. Their goal is to help develop better writers along with better writing and reflection through continual revision. If you need assistance with writing assignments, they can be contacted at: 773.325.4272 (LPC) or wcenter@depaul.edu

### 11. Frequently Asked Questions

**A. Where and when can I use GIS software on campus?**

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Hour</th>
<th># Computers</th>
</tr>
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<tbody>
<tr>
<td>GIS Lab</td>
<td>SAC 224</td>
<td>Check the door</td>
<td>27</td>
</tr>
<tr>
<td>QRC Lab</td>
<td>SAC 268</td>
<td>See <a href="#">QRC website</a></td>
<td>27</td>
</tr>
<tr>
<td>GEO Lab</td>
<td>990 W Fullerton, Rm# 4515</td>
<td>9-5</td>
<td>3</td>
</tr>
<tr>
<td>Richardson Lab*</td>
<td>2350 N Kenmore</td>
<td>See <a href="#">Library website</a></td>
<td>?</td>
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**B. Is there any way that I can have ArcGIS 10 installed in my personal computer?**


**C. I lost my USB drive. What should I do?**

Check out in Quantitative Reasoning Center (QRC) located at SAC 268. It’s most likely that your flash drive is at QRC unless somebody took it. Contact a QRC at (773) 325-4663 or by e-mail Jennifer at JGALKA1@depaul.edu.
Appendix A. Department of Geography Learning Goals

GEO344 addresses learning goals 1, 2, 5, 6, and 7.

Courses in the Department of Geography teach students:

1. **Understand spatial patterns and processes of modification of the Earth’s physical and cultural landscapes**
   (a) As social constructions.
   (b) As systems that link the Earth with human society in interdependent, dialectical relationships, and
   (c) Through mapping and visualization.

2. **Understand the concept of scale as a spatial phenomenon that ties the local, the regional, the national, the transnational, and the global in a system of interaction.**

3. Understand the phenomenology of the discipline of Geography—most importantly, “space”, "place", "landscape," "region," and "location".

4. Distinguish that spaces, places, and so on, may have both objective and subjective/symbolic dimensions.

5. **Develop research and writing competences that would allow you to:**
   (a) Formulate a cogent research question about the spatial character of a physical, socio-cultural, or environment-societal phenomenon,
   (b) Write about it in ways that reflect analytical and critical thinking, and
   (c) Ethical concern over social and environmental justice, consistent with the University’s social mission.

6. **Engage competently in qualitative and quantitative spatial analysis, and with exercises that are concerned with explaining spatial regularities (for example, the spatial calculus behind the location of retail commerce in Chicago, or transnational flows of capital).**

7. **Learn the basic utility and use competently one or more of the information technologies that are now redefining the logistical limits of spatial analysis: geographic information systems (GIS) and remote sensing.**

8. Achieve greater general knowledge of the world, its regions, its physical systems, its cultures, and political-territorial divisions.
Appendix B. Harvard Referencing Style

Reference Lists:

Reference lists must be in alphabetical order by author’s last name. Items by the same author must be in chronological order. Indent all but the first line of the citation. Please use the following style:

When referencing a direct quotation:
Knox and Pinch (2000: p.172) argue that “social polarization has been taking place.”

When referencing an idea:
According to Knox and Pinch (2000), there has been social polarization.

Books:


Book chapters in an edited collection:


Journal articles:


Internet articles: