

GEO244: GIS III (Sustainable Development Perspectives)

Syllabus | Spring 2008-2009 | DePaul University

1. Meeting: Tue/Thur 3:10-4:40 PM at GIS Lab (Schmitt Academic Center 224 in Lincoln Park Campus)

2. Instructors: Julie Hwang (shwang9@depaul.edu, 990 W Fullerton Room# 4513, Office hour: Wed 3-5 PM and by appointment), Diana Maties (usgirl_16@yahoo.com, Lab hour: TBA)

3. Course overview

GEO244 looks into advanced GIS concepts and analytical methods applicable to addressing sustainability issues. The course content falls into largely three categories organized in sequence. First, you will be introduced to concept and useful constructs of sustainable development (such as indicators) to pave the way to GIS-based sustainability analysis. Second, you will learn GIS analytical methods that can be applied to addressing sustainability issues (such as promoting bicycling, monitoring air quality, exploring community demographics, and measuring access) through lab activities; you will learn how to identify spatial pattern from object point data (point pattern analysis), estimate z values from field point data stochastically (geostatistical analysis), explore spatial data open-mindedly (exploratory spatial data analysis), and perform network analysis. Third (time & circumstance permitting), we will discuss the institutional environment that needs to be put in place to ensure the successful implementation of “GIS for sustainable development” types of project; we will focus on data acquisition and decision making process. Students’ work will be evaluated on the basis of a take-home exam, a term paper, labs, and participation. GEO242 (GIS II) and GEO243 (Remote Sensing) are prerequisites to GEO244.

4. Learning Goals

At the end of this course, you should be able to

- Apply methods of spatial analysis and information visualization techniques to sustainability-related problems *appropriately*
- Elaborate on the role of GIS in achieving sustainability in three functional areas of GIS – measurement (indicators), analysis (tools), and institutional implementation *critically*
- Conduct an interdisciplinary empirical research using GIS on your own *competently*

Detailed learning objectives aimed at achieving these goals are provided in **Appendix A**.

5. Outline of Course Contents

Part I. Conceptual basis for addressing sustainability issues

- What is sustainable development?
- Themes and issues of sustainable development

- Analytical framework and indicators of sustainable development
- Sustainable development and geography

Part II. Identifying and analyzing sustainability problems

- Statistical foundation for spatial data analysis
- Point pattern analysis
- Geostatistical analysis
- Exploratory spatial data analysis
- Network analysis
- Analyzing spatial relationship

Part III. Linking knowledge to action toward sustainability

- Spatial data infrastructure
- Participatory GIS

6. Grading Components

Exam	25%	Take-home during final exams week
Labs	20%	Every Thursday during week 4-7
Term paper	45%	Composed of six milestones
Attendance	10%	Sign-up sheet circulated every class
Participation (extra credit)	5%	Your contribution to others' learning

Exam

Take-home exam anytime during June 9 - 12 to be determined democratically

No s/w test - all written essay questions

Appendix A as a sort of study guide (to be revised)

Labs

Four labs to be graded equally, short answer to half dozen questions, due one week after labs

Lab1 – identify spatial pattern of bicycle crash location in Chicagoland

Lab2 – map ozone level in California using Kriging

Lab3 – explore sustainability indicators compiled from census data in Northside Chicago

Lab4 – measure network distance between origin and destination in Northside Chicago

Term paper

1) Requirements

- GIS (strong) + sustainability (perhaps strong): The paper should address both GIS and sustainability issues. GIS components are required while sustainability components may be waived if excused.

- Advanced GIS analytical methods (strong): Advanced - GIS components of your paper must reflect the level of GEO244. For example, the mere mapping of readily available data won't be considered to meet this requirement. Analytical method - GIS analytical methods learned from GEO244 should be employed whenever possible.
- Scientific method of empirical research (strong): The paper should employ scientific methods (most likely to be quantitative although qualitative research is encouraged also) to conduct empirical research. If you have taken GEO391 (research technique), follow the guidelines.
- Critical thinking (strong): As a capstone GIS course, it is expected that the paper demonstrates that you are a critical thinker in understanding GIS concepts and making use of skills.

2) Choosing a term paper topic

Looking at sustainable development topics in three aspects – themes, issues, and programs - may help you choose a topic. Examples of these are

- ❖ Themes: health, education, atmosphere
- ❖ Issues: combating poverty, changing consumption patterns, protecting the atmosphere. See **Appendix B** (Agenda 21 Table of Contents) for more examples.
- ❖ Programs: green building, growth control, brownfield development, affordable housing, congestion pricing

Themes can be thought of as major categories of knowledge or subject matter. Issues are more or less seen as the problem to be tackled. Programs are actions or policy measures taken to address problems. You can write a paper about a specific theme, or a specific issue, or a specific program that you are interested in. Then you will narrow down the topic and become clearer about how to conduct analysis as time progresses.

Term paper topics from the previous quarter range from brownfield development, food deserts, health effects of coal power plants, access to public transportation, environmental justice, water quality monitoring, sustainable coastal tourism management, to transit-oriented development.

3) Milestones

Acronym	Title	Due date	Points	Length
P1	Proposal	4/16	2	1-2 paragraphs
P2	Annotated bibliography	4/28	3	1-2 pages
P3	Data acquisition report	5/12	2	1-2 paragraphs
P4	Data analysis report	5/26	3	1 page
P5	Presentation	6/4, 6/8	5	fit to 15 min.
P6	Term paper (final report)	6/8	30	10 pages

- P2 - P4 includes refined and revised proposal if applicable.
- Length is estimated on the basis of single-spacing except for P6, and is contingent upon the nature of your term paper
- The specification of data acquisition and data analysis report will be similar to that of GEO242 stage report, but they should be written in a much more succinct manner
- P6 is expected to be written with a double-spacing excluding figures and references. Suggested sections of P6 would be introduction, literature review, method, results, conclusions, and references

4) Type of operation

Individual vs. group: You can work either as an individual or as a group with any number less than 5.

Research vs. service: Writing a term paper based on service experience will be also considered as an empirical research. I can arrange the meeting between any group of interested people and ENLACE (community-based organization in Little Village) which has a GIS project ready to conduct this quarter. See **Appendix C** for more on Little Village and ENLACE.

7. Tentative Schedules and Readings

All readings listed below (marked as bullet points) are posted or will be posted on the Blackboard (click Readings Tab on the left). Before you read, refer to **Appendix A** (Course objectives) for contents to be covered in the class. Contents are subject to change at the discretion of an instructor.

Part I. Conceptual Basis for Addressing Sustainability Issues

March 31 (Tue): Course overview. We will arrange the plan for April 7 presentation – who will present which chapter of Agenda 21. See Appendix B.

April 2 (Thurs): What is Sustainable Development?

- Purvis and Grainger 2005: Exploring Sustainable Development – Geographical Perspectives, Chapter 1 (Introduction)

April 7 (Tue): Themes and Issues of Sustainable Development

- UN Agenda 21:
<http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21toc.htm>

Submit one or two page summary of each chapter of Agenda 21, and share your findings

April 9 (Thurs): Analytical Framework and Indicators of Sustainable Development

- International Council for Science 2005: Harnessing Science, Technology, and Innovation for Sustainable Development, Section 2.1 (pp. 13-15)
- United Nations 2007: Indicators of Sustainable Development – Guidelines and Methodologies, Section V (pp. 39-45)
- Meadows 1998: Indicators and Information Systems for Sustainable Development, Section 6 (pp. 40-71)
- United Nations 2007: Indicators of Sustainable Development – Guidelines and Methodologies, Table 1 (pp. 10-14)

April 14 (Tue): Sustainable Development and Geography

- Purvis and Grainger 2005: Exploring Sustainable Development – Geographical Perspectives, Chapter 2 (Geography and Sustainable Development)

Part II. Identifying and Analyzing Sustainability Problems

April 16 (Thurs): Statistical Foundation for Spatial Data Analysis

- Rogerson 2006: Statistical Methods for Geography, Chapter 1 (Introduction to Statistical Methods for Geography) Section 1.1 – 1.7
- Rogerson 2006: Statistical Methods for Geography, Chapter 5 (Inferential Statistics: Confidence Intervals, Hypothesis Testing and Sampling) Section 5.1-5.5
- MiniTab 15 Manual: <http://www.minitab.com/support/docs/rel15/MeetMinitab.pdf>

April 21, 23 (Tue/Thurs): Analyzing Spatial Object Framework (Point Pattern Analysis) & Lab1

- Bailey and Gatrell 1996: Interactive Spatial Data Analysis, Chapter 3 (Introductory Methods for Point Patterns)
- O’Sullivan and Unwin 2003: Geographic Information Analysis, Chapter 4 (Point Pattern Analysis) – this is a supplemental reading in case Bailey and Gatrell is hard to follow
- CrimeStat III User Workbook: <http://www.icpsr.umich.edu/CRIMESTAT/workbook.html>. You can also download the workbook from the Blackboard

April 28, 30 (Tue/Thurs): Analyzing Spatial Control Framework (Geostatistical Analysis) & Lab2

- NCGIA Core Curriculum 1990 Version Unit 40 (Spatial Interpolation): <http://www.geog.ubc.ca/courses/klink/gis.notes/ncgia/u40.html#UNIT40>
- de Smith et al 2007: Geospatial Analysis, Section 6.7 (Geostatistical Interpolation Methods), p. 304 -320
- O’Sullivan and Unwin 2003: Geographic Information Analysis, Chapter 9 (Knowing the Unknowable: The Statistics of Fields) Section 9.4 (pp. 265-281) – this is a supplemental reading in case de Smith is hard to follow
- ArcGIS Geostatistical Analyst Tutorial : Hyperlinked from the help system, ArcGIS Desktop Help – Contents – Getting started – Tutorials – Geostatistical Analyst Tutorial. You can also

find the PDF files Geostatistical_Analyst_Tutorial.pdf in C:\Program Files\ArcGIS\Documentation\ in GIS lab

May 5, 7 (Tue/Thurs): Analyzing Choropleth Framework (Exploratory Spatial Data Analysis) & Lab3

- Anselin 2005: Geographical Information Systems – Principles, Techniques, Management and Applications, Chapter 17 (Interactive Techniques and Exploratory Spatial Data Analysis)
- GeoDa Workbook: <http://geodacenter.asu.edu/system/files/geodaworkbook.pdf>. You can also download the workbook from the Blackboard

May 12, 14 (Tue/Thurs): Analyzing Network Framework (Network Analysis) & Lab4

- Waters 2005: Geographical Information Systems – Principles, Techniques, Management and Applications, Chapter 59 (Transportation GIS: GIS-T)
- ArcGIS Network Analyst Tutorial: Hyperlinked from the help system, ArcGIS Desktop Help – Contents – Getting started – Tutorials – Network Analyst Tutorial. You can also find the PDF files Network_Analyst_Tutorial.pdf in C:\Program Files\ArcGIS\Documentation\ in GIS lab

May 19 (Tue): Reflections on Spatial Analysis

May 21 (Thurs): Framework for Analyzing Spatial Relationship

- Mitchell 2005: The ESRI Guide to GIS Analysis – Volume 2: Spatial Measurements & Statistics, Chapter 5 (Analyzing Geographic Relationships)

Part III. Linking Knowledge to Action toward Sustainable Development *if time and circumstance allow*

May 26 (Tue): Data Acquisition, Sustainability, and GIS (Spatial Data Infrastructure)

- Cowen 2007: The Handbook of Geographic Information Science, Chapter 1 (The Availability of Geographic Data – the Current Technical and Institutional Environment)
- Rajabifard et al 2005: Developing Spatial Data Infrastructure – From Concept to Reality, Chapter 2 (Spatial Data Infrastructures – Concept, Nature and SDI Hierarchy)

May 28 (Thurs): Decision Making, Sustainability, and GIS (Participatory GIS)

- Weiner and Harris 2007: The Handbook of Geographic Information Science, Chapter 26 (Participatory Geographic Information Systems)
- Jankowski and Nyerges 2007: The Handbook of Geographic Information Science, Chapter 27 (Geographic Information Systems and Participatory Decision Making)

June 2 (Tue): 3:10-4:40 Term paper help

June 4 (Thurs) 3:10-4:40 Student Presentation

June 8 (Mon) 2:45-5:00 Student Presentation

8. Frequently Asked Questions

1) Where and when can I use GIS software?

Name	Location	Hour	GIS-related software	# Computers
GIS Lab	SAC 224	See QRC website	ArcGIS, MiniTab, GeoDa	27
QRC	SAC 268	See QRC website	ArcGIS, MiniTab	27
DB search room	Richardson	See Library website	ArcGIS, MiniTab	2
Geo Lab	Geography	9-5	ArcGIS, MiniTab, GeoDa	2

Update: 1) Now StreetMap05 data can be retrieved from C:\ArcGIS\StreetMap05 at all locations above except for QRC (Quantitative Reasoning Center) 2) ArcGIS 9.3 is now installed in Geo Lab.

2) Can I use ArcGIS in my personal computer?

Yes. Order 60-day evaluation copy at www.esri.com/software/arcgis/arcview/eval/evalcd.html. The CD will be delivered to you at no cost. Expect more than two weeks to receive the CD. Julie also has several evaluation copies of old versions ready to be given away. Note that evaluation copy does not come with extensions such as Geostatistical Analyst, and does not work in Mac.

3) I lost my USB drive. Is there anywhere to look for my USB drive like lost & found?

Yes. It's most likely that your flash drive is at QRC (SAC268) unless it's already stolen. Contact a QRC lab manager, Jennifer Galka by phone (773) 325-4663 or by e-mail JGALKA1@depaul.edu.

To help her identify who a lost flash drive belongs to, I suggest that you put a word document called "Open if Lost" in the main directory of your flash drive. In the document, you can put your name and an e-mail address so that you can be contacted in case the flash drive is found.

9. Miscellaneous

Grading scale

Points earned	Letter grade
- 93-100 points	A
- 90-92.99 points	A-
- 87-89.99 points	B+
- 83-86.99 points	B
- 80-82.99 points	B-
- 77-79.99 points	C+
- 73-76.99 points	C
- 70-72.99 points	C-
- 50-69.99 points	D
- < 50	F

Academic Integrity

Work done for this course must adhere to the University Academic Integrity Policy, which you can review in the *Student Handbook* or by visiting <http://studentaffairs.depaul.edu/homehandbook.html>.

Appendix A: GEO244 Learning Objectives

This is largely intended to provide you with clarity and focus in course contents. Revised versions will be provided whenever necessary. Answers to learning objectives or questions listed below can be clearly gathered from course readings unless other resources are provided and questions are for open-ended discussion. At the end of taking GEO244, you should be able to

Part I. Conceptual Basis for Addressing Sustainability Issues

Unit 1. What is sustainable development?

1. Describe how discourses of sustainable development began and have evolved
2. Describe the difference between economic growth, economic development, and sustainable development
3. Explain the concept of capitals such as built capital, human capital, and natural capital.
4. Describe the difference between ecological economics and environmental economics in their views of sustainable development

Unit 2. Themes and Issues of Sustainable Development

5. Identify major themes of sustainable development (e.g., health, education, atmosphere)
Useful resource: http://www.un.org/esa/sustdev/natlinfo/indicators/isdms2001/table_4.htm
6. Identify important issues of sustainable development (e.g., combating poverty, changing consumption patterns, protecting the atmosphere)
Useful resource: [Agenda 21](#)
7. Identify actions (or programs) taken (implemented) and to be taken (conceived) to address issues of sustainable development (e.g., green building, growth control, affordable housing, congestion pricing)
Useful resource: [Toward Sustainable Community by Roseland \(2005\)](#)
8. Discuss core values and perspectives sustainable development embodies

Unit 3. Analytical Framework and Indicators of Sustainable Development

9. Discuss analytical framework of sustainable development. That is, discuss the how (procedures of scientific investigation) science and technology can be harnessed to promote sustainable development
10. Describe different organizing framework of sustainable development indicators (e.g., DPSIR, Capital framework)
11. Organize indicators of sustainable development within Daly Triangle (or Capital framework)
12. Pick sample indicators from UN 2007 report in relation to your term paper if possible, and discuss measurement issues with GIS implementation in mind

Unit 4. Sustainable Development and Geography

13. Identify geographic concept that intersects the notion of sustainable development drawing on your experience such as course works, community serving, and media in addition to reading
14. Discuss the role of geographic perspectives in better understanding sustainable development as theoretical concepts and/or achieving sustainable development as policy goals

Part II. Identifying and Analyzing Sustainability Problems

Unit 5. Statistical Foundation for Spatial Data Analysis

15. Describe procedures of scientific method
16. Compare and contrast exploratory and confirmatory approaches to conducting an empirical research in geography
17. Describe special considerations for spatial data in comparison with non-spatial data
18. Explain the concept of hypothesis testing and confidence intervals
19. Discuss functions and pitfalls of inferential statistics
20. Obtain descriptive statistics, create graphs, and run a simple significance test using MiniTab

Unit 6. Analyzing Spatial Object Framework (Point Pattern Analysis)

21. Compare and contrast first order properties and second order properties in spatial data analysis
22. Describe how quadrat analysis works
23. Describe how kernel density estimation works
24. Describe how nearest neighbor analysis works
25. Describe how K function works
26. Conduct point pattern analysis using CrimeStat (Lab1)

Unit 7. Analyzing Spatial Control Framework (Geostatistical Analysis)

27. Classify spatial interpolation methods (e.g., deterministic vs. stochastic method)
28. Describe constructs of Kriging, such as semivariogram, anisotropy, and detrending
29. Describe steps of Kriging
30. Conduct Kriging using Geostatistical Analyst (Lab 2)

Unit 8. Analyzing Choropleth Framework (Exploratory Spatial Data Analysis)

31. Understand the principles of exploratory data analysis (EDA)
32. Understand the principles of exploratory spatial data analysis (ESDA)
33. Describe EDA & ESDA techniques (e.g., Box plot, parallel coordinate plot, Moran's I, Moran Scatterplot, LISA map)
34. Discuss utility of ESDA in conducting an empirical research with link to your term paper
35. Conduct ESDA using GeoDa and ArcGIS (Lab3)

Unit 9. Analyzing Network Framework (Network Analysis)

36. Describe data structure used in GIS-T (e.g., link-node model, dynamic segmentation)

37. Describe operations of GIS-T (e.g., routing, location-allocation modeling)
38. Describe considerations of path-finding algorithm (such as detailed specification of data structure, data requirement, and details of operations)
39. Conduct network analysis using Network Analyst (Lab4)

Unit 10. Reflections on Spatial Analysis

40. Critique the respective method of spatial analysis covered in previous units
41. Discuss pitfalls and potential of spatial analysis
42. Discuss issues arising from the discrepancy between spatial concept and its metrics in conducting spatial analysis for your term paper. For example, is Moran's I a good measure of spatial autocorrelation pertinent to your data?

Unit 11. Analyzing Spatial Relationship

43. Describe existing techniques for analyzing spatial relationship, such as correlation analysis and regression analysis
44. Discuss issues with analyzing spatial relationship of geographic information in different measurement frameworks. For example, what should be considered in integrating pollution data (spatial control framework) with school location data (spatial object framework)?

Part III. Linking Knowledge to Action toward Sustainability

Unit 12. Data Acquisition, Sustainability, and GIS (Spatial Data Infrastructure)

45. Understand the importance of institutional arrangement for data acquisition toward sustainable development
46. Explain the tenet of spatial data infrastructure
47. Describe components of spatial data infrastructure
Useful resource: <http://www.fgdc.gov/training/nsdi-training-program/materials/NSDIOverview>. After download, change the file name to NSDIOverview.ppt
48. Outline existing institutional efforts to promote spatial data infrastructure (e.g., SDTS, FGDC Metadata standard, Open Geospatial Consortium, Geospatial One-Stop)

Unit 13. Decision Making, Sustainability, and GIS (Participatory GIS)

49. Discuss implications of findings from "Public Participation GIS (PPGIS)" projects in fostering sustainable development
50. Discuss implications of findings from "GIS for participatory decision making" projects in fostering sustainable development

Appendix B. Agenda 21 – Table of Contents

Chapter	Paragraphs
1. Preamble	1.1 - 1.6
SECTION I. SOCIAL AND ECONOMIC DIMENSIONS	
2. International cooperation to accelerate sustainable development in developing countries and related domestic policies	2.1 - 2.43
3. Combating poverty	3.1 - 3.12
4. Changing consumption patterns	4.1 - 4.27
5. Demographic dynamics and sustainability	5.1 - 5.66
6. Protecting and promoting human health conditions	6.1 - 6.46
7. Promoting sustainable human settlement development	7.1 - 7.80
8. Integrating environment and development in decision-making	8.1 - 8.54
SECTION II. CONSERVATION AND MANAGEMENT OF RESOURCES FOR DEVELOPMENT	
9. Protection of the atmosphere	9.1 - 9.35
10. Integrated approach to the planning and management of land resources	10.1 - 10.18
11. Combating deforestation	11.1 - 11.40
12. Managing fragile ecosystems: combating desertification and drought	12.1 - 12.63
13. Managing fragile ecosystems: sustainable mountain development	13.1 - 13.24
14. Promoting sustainable agriculture and rural development	14.1 - 14.104
15. Conservation of biological diversity	15.1 - 15.11
16. Environmentally sound management of biotechnology	16.1 - 16.46

17. Protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources	17.1 - 17.136
18. Protection of the quality and supply of freshwater resources: application of integrated approaches to the development, management and use of water resources	18.1 - 18.90
19. Environmentally sound management of toxic chemicals, including prevention of illegal international traffic in toxic and dangerous products	19.1 - 19.76
20. Environmentally sound management of hazardous wastes, in hazardous wastes	20.1 - 20.46
21. Environmentally sound management of solid wastes and sewage-related issues	21.1 - 21.49
22. Safe and environmentally sound management of radioactive wastes	22.1 - 22.9

SECTION III. STRENGTHENING THE ROLE OF MAJOR GROUPS

23. Preamble	23.1 - 23.4
24. Global action for women towards sustainable and equitable development	24.1 - 24.12
25. Children and youth in sustainable development	25.1 - 25.17
26. Recognizing and strengthening the role of indigenous people and their communities	26.1 - 26.9
27. Strengthening the role of non-governmental organizations: partners for sustainable development	27.1 - 27.13
28. Local authorities' initiatives in support of Agenda 21	28.1 - 28.7
29. Strengthening the role of workers and their trade unions	29.1 - 29.14
30. Strengthening the role of business and industry	30.1 - 30.30
31. Scientific and technological community	31.1 - 31.12
32. Strengthening the role of farmers	32.1 - 32.14

SECTION IV. MEANS OF IMPLEMENTATION

33. Financial resources and mechanisms	33.1 - 33.21
34. Transfer of environmentally sound technology, cooperation and capacity-building	34.1 - 34.29
35. Science for sustainable development	35.1 - 35.25
36. Promoting education, public awareness and training	36.1 - 36.27
37. National mechanisms and international cooperation for capacity-building in developing countries	37.1 - 37.13
38. International institutional arrangements	38.1 - 38.45
39. International legal instruments and mechanisms	39.1 - 39.10
40. Information for decision-making	40.1 - 40.30

Source URL: <http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21toc.htm>

Appendix C. Little Village and ENLACE

For some information about the agency and the neighborhood, visit LISC Little Village link:

<http://newcommunities.org/communities/littlevillage/>

Contact person: Edgar Ramirez eramirez@enlacechicago.org

Brief description of GIS project: ENLACE is interested in mapping the location of community leaders and participants to streamline community organizing effort. They envision this project as a group project that might require three to five people.

Instructor's comment: If you are interested in how GIS is used to promote public participation (more specifically, how general public views GIS, how local knowledge can be incorporated into GIS, and understanding how institutional structure affects GIS design and so on), this community service experience may provide a good opportunity through which you learn this topic by first hand. Also they would presumably provide data in some form, there is no need for data collection from scratch. Note that this is likely to be a group work, so group formation is the key at this point.

If you're interested, talk to Julie for arranging the meeting anytime *ahead of* the due date of proposal (April 16)