Course Description:
(Prerequisites: Undergraduate Statistics) This course introduces students to basic spatial analytic skills. It covers introductory concepts and tools in the area of Geographic Information Systems (GIS); including spatial data acquisition, spatial data management, and spatial data analysis. As well, the course introduces students to the process of developing and writing an original spatial research project. The focus of this course on spatial analysis recognizes the fact that (GIS) has become an increasingly useful tool for observing and analyzing social and physical phenomena over space. Most of the physical and social sciences, as well as a number of professions, are currently building an infrastructure of GIS data that allows for new interdisciplinary analyses to occur and for unexamined potential spatial relationships to be uncovered. This is especially true for social scientific analyses, where a wealth of spatial data on cultural, economic, physical, and demographic characteristics remain unexamined…. but easily accessible from a number of sources. Students will do a series of in-class labs and develop a final research project from the materials and methods covered in these labs. In addition, the course will require a set of short response papers (4) and two exams (midterm and final).

Required Texts:
  - *(Full Content Available as eBook from Columbia University Library)*.
  - *(Full Content Available as eBook from Columbia University Library).*
Optional Texts: the following texts could prove very useful but they are not required:


Required Listserv Subscription:

You are “required” to subscribe to the following Internet Listserv during the semester. This subscription must be completed by the end of the first week of class. Note that each has a “digest” format as well as web-based archives so that you can manage your inbox more effectively.

Listserv for Openspace -- Open source spatial analysis software tools: http://geodacenter.asu.edu/support/community

The following websites are useful for your future in using GIS and we will visit them at various times throughout the semester for reading and lab materials:

- Center for Spatially Integrated Social Science (http://www.csiss.org)
- GeoDa Center, Arizona State University (http://geodacenter.asu.edu)
- Luc Anselin (http://geography.asu.edu/anselin)
- Bradley P. Carlin (http://www.biostat.umn.edu/~brad)
- Peter J. Diggle (http://www.lancs.ac.uk/staff/diggle)
- Stewart Fotheringham (http://ncg.nuim.ie/ncg/people/staff/fotheringham/index.shtml)
- Andrew Lawson (http://www.sph.sc.edu/alawson)
- Serge Rey (http://geography.asu.edu/rey)
- Peter Rogerson (http://www.acsu.buffalo.edu/~rogerson/)
- David M. Theobald (http://www.nrel.colostate.edu/~davet/)
- GeoVISTA Center, Penn State University (http://www.geovista.psu.edu/index.jsp)
- S4: Spatial Structures in the Social Sciences (http://www.s4.brown.edu)
- ESRI website (http://www.esri.com) & ESRI Virtual Campus (http://training.esri.com)
- National Center for Geographic Information & Analysis (http://www.ncgia.ucsb.edu)
- Al-Geostats: (http://www.ai-geostats.org)
- Open Geospatial Consortium, Inc. (http://www.opengeospatial.org)
- U.S. National Atlas (http://nationalatlas.gov)
- Census Bureau Geography Division (http://www.census.gov/geo/www/)
- Jenness Enterprises: (http://www.jennessent.com/)

COURSE OVERVIEW:

Overview. Most social data have or can have a spatial element to them—crimes are committed at a location, unemployment is tracked by city or county, the location of hazardous waste sites occur in some spatial proximity to human populations, consumers purchase products at stores located in specific places, populations grow and decline in relative proximity to larger urban centers, disease and death are distributed unevenly across space, and social inequality is spatially-situated—but conventional procedures of social data analysis do not make use of this important information. In response to this gap in knowledge, the National Science Foundation sponsored the Center for Spatially-Integrated Social Science (CSISS) to serve as a catalyst for the better understanding of social phenomena using spatial
analysis procedures (see Goodchild et al. 2000). Since then many others have followed.

The course is designed to give you introductory training in the spatial analysis of social data. While this course introduces the use of modern techniques of spatial analysis applied to social data, the explosion in quantitative social science methods during the past 25 years or so makes the effective learning of these methods a process that must transpire over a period of several years. It is therefore important for students enrolled in this course to accept the necessity of continuing their quantitative training in GIS and Spatial Analysis beyond actual course work and as a commitment to their professional development. This course should perhaps be best viewed as just one important step in that process of the development of proficient skills in GIS and spatial analysis.

**Objectives.** The objectives of the course are to acquaint graduate students with methods to analyze spatially-referenced data with the procedures appropriate for a social science’s theoretical base. The course contact hours are organized into three major foci: (a) essential theoretical concepts and the constituent reference to Census Bureau demography (including the digital TIGER database); (b) the visualization of social data facilitated by Geographic Information Systems software; and (c) techniques to construct or analyze social point, line, and polygon data using exploratory and confirmatory spatially-centered analytical approaches. Weekly readings and homework will emphasize applications of these procedures to actual social theories and data using a pedagogical model of: application, interpretation, and presentation of empirical analyses by students. The semester-length project is a key instrument by which students will demonstrate competence in spatial analysis methods covered in the course.

**Grading Procedures.** The requirements of the course include midterm and final exam, completion of all homework assignments in a timely manner, a series of short summary papers from the required Goodchild and Janelle text, and a semester length research project. The midterm and final exam will be essay, application and interpretation based and will be completed in a take-home exam format. The semester-length research project will result in an electronic presentation in a colloquium setting using Microsoft Powerpoint (or equivalent) with an accompanying research paper. The topic and scope of the research project must be approved by the Instructor. This research project must use spatial data to address some theoretically-driven research problem. The topic, abstract, annotated bibliography, and proposal of methodology will all be due at various points throughout the semester (documented on the attached course schedule).

The final semester grade will be computed as:

- 40% for the midterm and final exams (20% each)
- 30% for final research project (25% for research paper and 5% for periodic updates)
- 30% of the grade will be made up of in-class lab and homework grades.

The course grades will be assigned letter grades using a conventional breakdown of final averages:

A=90-100; B=80-89; C=70-79; D=60-69; F=below 60.
COURSE TOPICS AND GENERAL SCHEDULE:
(Note: this schedule is subject to change at the discretion of the Instructor. The projected timing for each topic is shown at left. The sequence will generally be followed verbatim. Key readings are shown in parenthesis to the right of each entry. A reference list is included at the end of this course outline.)

Week 1.
(09/08)

Organization and Course Introduction

Week 2.
(09/15)

Social theories involving space, place, and reflexive relationships

1. Making a Place for Space: Spatial Thinking in the Social Sciences (Logan 2012).
2. Theoretical Foundations of the Sociology of Location (Porter and Howell 2012 pages 1-62)
3. Hawley’s Social Ecology of Space (Duncan and Schnore 1959)
4. Social Field Theory (Kaufman 1959)

Weeks 3 & 4. (Due by 09/29: Topic & 1 paragraph abstract (stating purpose) for Research Project)
(09/22 & 09/29)

Social Demography Concepts and Databases

5. Howell, Porter and Matthews (CH 1-2)
6. Census Bureau geographic hierarchy (Census GARM)
7. Major Spatial Data Sources: TIGER, USDOT, USGS
   (Census TIGER Documentation; USGS 1995; plus the following websites:
   GeoData Website [http://www.geodat.gov](http://www.geodat.gov); Federal Geographic Data Committee clearinghouse
   [http://clearinghouse1.fgdc.gov](http://clearinghouse1.fgdc.gov)
   U.S. Bureau of Transportation Statistics
   U.S. EPA Envirofacts Data Warehouse
   [http://www.epa.gov/enviro/](http://www.epa.gov/enviro/)
8. Selected commercial sources of spatial data
   (Geography Network [http://www.geographynetwork.com](http://www.geographynetwork.com)
   (Geocommunity Data Depot [http://gisdatadepot.com/](http://gisdatadepot.com/))

Weeks 5
(10/06)

Visualizing Social Data Using Geographic Information Systems

9. Spatial concepts, operations, and data types (Porter and Howell 67-114)
10. Howell, Porter, and Matthews (CH 3-6)
11. Accessing Census and other datasets, extracting spatially-referenced TIGER data, and building GIS coverages (TIGER Documentation)

Week 6
(10/13)

CLASS CANCELLED (Instructor out of Town)

Good use of time: work on Annotated Bibliography
(Due by 10/27: Annotated Bibliography for Research Project [min. of 10 cites])
Week 7

Take Home Midterm (Due by midnight 10/23 [Sunday])

Weeks 8 & 9
10/27 & 11/3

Geo-Processing of Spatial Data

12. Howell, Porter and Matthews (CH. 7-8)

Weeks 10 & 11

Identifying Statistical Clusters and Exploratory Spatial Data Analysis (ESDA) of Social Data

15. Construction and evaluation of spatial weights: contiguity, distance, and nearest-neighbors (Anselin 2003a,b,c)
16. Identification and visualization of spatial autocorrelation patterns using Moran’s I, Local Indicators of Spatial Association (LISA), and Moran scatterplots linked to LISA maps (Anselin 2003a,b; Anselin, Syabri, and Smirnov 2002)

Week 12
11/24

(No Class: Thanksgiving Break)

Weeks 13
12/1

(Due by 12/01: Short Proposal of Data and Spatial Components for Research Project)

Introduction to Spatially Weighted Regression Models

17. Classes of spatial regression models
   a. Continuous surface vs. lattice models (Anselin & Bera 1998)
   b. Global vs. local models (Fotheringham et al. 2002)
   c. Space vs. time models (Kuldorff 1997; Levine 2002)
18. Global spatial regression models
   a. Conventional OLS regression models of demographic data (Anselin 1988)
   b. Diagnostic tests for spatial dependence and heterogeneity in OLS models (Anselin 2002)
   c. Specifying and estimating spatial lag and spatial error models (Anselin & Cho 2002a,b; Anselin & Moreno 2002)

Week 14.
12/08

OPEN LAB: Research Project Workshop (For those who want help)
Take home Final Exam made available
Final Exam Date: Final Exam and Final Paper Due by midnight 12/22
Semester Length Research Project:

There is a single semester length research project in which students are expected to engage in the spatial analysis of an instructor approved topic for presentation and submission of research paper at the end of the semester. There are a couple of important factors to consider when thinking about one’s project. 1) What am I interested in?, 2) Are there spatially referenced data available (or data that could be constructed from existing sources)?, and 3) What is the purpose of my proposed research? In order to help along the way, the following due dates are related to the development of the semester length research project.

1) Topic and 1 paragraph abstract (Due: 09/29)
2) Annotated Bibliography with minimum of 10 academic sources (Due: 10/27)
3) Short Proposal of Data and Spatial Components for Research Project (Due: 12/01)
4) Final Research Paper due (12/22)

The final research paper is intended to resemble an early draft of a research manuscript and should include at least the following sections (with loose page guidelines): Introduction (~1-2 pages), Review of Literature (~4-6 pages), Methodology (~2-3 pages), Results (~3-5 pages), Discussion/Conclusion sections (~1-2 pages), and References (with minimum of 10 academic sources).

An exact page limit will not be set (guidelines listed above for sections), but it is expected that the final research paper should meet the standards of what would be expected from a full semester project.
References to Syllabus:


Anselin, Luc. 2003a. GeoDa 0.9 User’s Guide. Center for the Spatial Integration of Social Sciences and Spatial Analysis Laboratory, University of Illinois. Urbana, IL: University of Illinois.

Anselin, Luc. 2003b. An Introduction to EDA with GeoDa. Spatial Analysis Laboratory, University of Illinois.

Anselin, Luc. 2003c. An Introduction to Spatial Autocorrelation Analysis with GeoDa. Spatial Analysis Laboratory, University of Illinois.


Anselin, Luc. 2003e. An Introduction to Spatial Regression Analysis in R. Spatial Analysis Laboratory, University of Illinois.


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online at http://www.census.gov/geo/www/garm.html)

Bureau. (http://www.census.gov/geo/www/tiger/tiger2k/tiger2k.pdf)


Downey, Liam. 2006. “Using Geographic Information Systems to Reconceptualize Spatial

Duncan, Otis D. and Leo Schnore. 1959. "Cultural, behavioral, and ecological perspectives in the

Fotheringham, Chris Brunsdon, and Martin Charlton. 2002. Geographically Weighted Regression:
The Analysis of Spatially Varying Relationships. Wiley.

Fotheringham, A. Stewart, Chris Brunsdon, and Martin Charlton. 2000. Quantitative Geography:

WI: Agricultural Experiment Station, University of Wisconsin, May.

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University Press.


Green, Donald, Dara Z. Strolovitch, and Janelle S. Wong, "Defended Neighborhoods, Integration,

Haining, Robert. 1990. Spatial data analysis in the social and environmental sciences. Cambridge:
Cambridge University Press.

(1): 8-17.

King, Gary 2002. “Isolating Spatial Autocorrelation, Aggregation Bias, and Distributional
Violations in Ecological Inference: Comment on Anselin and Cho.” Political Analysis 10: 298-300.

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