URBDP 522: Urban and Regional Geospatial Analysis

Department of Urban Design and Planning

Winter 2015

Class Meetings: Tuesday & Thursday 8:30 - 9:20 am; Gould 007F (CM Lab)

Lab session: Tuesday & Thursday 9:30 - 10:20 am; Gould 007F (CM Lab)

Website: https://canvas.uw.edu/courses/950854

Instructor: Matt Patterson, Gould 432, Office Hours: Monday 1:30-3:30, Gould 432 e-mail: maspatte@uw.edu	Co-instructor: Jiawen Hu, Gould Office Hours: Thursday 12:30-2:30, CM Lab e-mail: jiawenhu@uw.edu

CM Lab (Gould 007F) Hours

Introduction

Course Description

This course provides theoretical and practical skills for analyzing spatial patterns and phenomena in metropolitan areas. Students will explore the functionality of geographic information systems (GIS) as an effective tool for analyzing and modeling complex spatial relationships within urban environments. Emphasis is given to data integration and modeling through both raster and vector systems. Selected case studies will be used to highlight data limitations and methodological complexities. In addition to the theoretical and technical foundations of GIS, students will develop and hone problem solving and spatial thinking skills, both critical to success in this course and your academic career. Problem solving is basic to the scientific method and refers to the process you will use to understand and reach a conclusion about something unknown. Spatial thinking is the process of understanding and recognizing objects within space and recognizing the importance of the space surrounding those objects and the relationships that occur within the whole system. Skills developed in this class will conclude with a final application (project) emphasizing principles and methods of spatial analysis applied to urban ecology problems in the central Puget Sound region.

Objectives

This course aims at the following four objectives:

1. Develop an understanding of spatial data and principles of spatial analysis.
2. Develop a proficiency in the analysis and evaluation of spatial data.
3. Develop technical skills to structure spatial data analysis and modeling in planning.
4. Develop and improve spatial problem solving abilities through the application of GIS knowledge and spatial thinking skills.

Course Structure and Assignments

This course is based on paired lectures and lab sessions.
In addition, students are expected to work on a team or individual project to apply spatial analysis to selected research questions.
Each team will be asked to produce a summary materials (5 page paper and digital data folder) describing the research question, methodology, and findings.
Project teams are expected to give a five-minute presentation at the end of the quarter.
A mid-term and a final exam are designed to examine students ability to master the spatial concepts and technical skills they have learned in the course.

Lab Sessions

Students will experiment with their computer skills through a set of Lab exercises.
Practical hands-on exercises are designed to help students learn GIS functions and explore their application for spatial analysis.
A number of lab sessions will be used for team projects.

Team Projects

Students are expected to develop a project scope, prepare data layers, conduct analysis, and synthesize findings.
Students will submit findings via a presentation, project brief and digital data folder.
Teams will be asked to present the analysis within the context of the larger research question, however focusing their project on the spatial analysis component.
Students having background in multi-regression and other multivariate statistical analysis are encouraged to explore the application of these techniques to analyze geospatial data.

Performance

You are expected to successfully complete the following activities:

1. All assigned readings prior to class (required readings are listed for each class in the syllabus).
2. All lab exercises using ArcGIS during the lab sessions.
3. A team project including a project report and presentation.
4. Mid-term exam.

Assignments

Lab exercises

For a schedule of exercises and assignments, see the course schedule.
Students are responsible for turning in assignments that accompany the lab exercises.
Homework submittal format will usually be a Word document or pdf with **embedded images** unless otherwise specified. Homework assignments are usually worth 10 points.

Assignments are due by **11:45 pm** on the day that they are due; you might have upload issues or have your internet fail, or something along these lines. Don't wait until the last minute.

Assignments are to be turned in using the course webpage for the Assignment.
Assignment files shall be titled as username_ex## (example: maspatte_ex02)
Late policy: for each day after the due date that assignments are turned-in, 1 point will be deducted from your grade. **Assignments will not be accepted more than 1 week late.**

Team Projects

The team project will provide you with the opportunity to apply specific GIS functions to a selected planning problem. You are expected to form project teams, select a planning question which involves the analysis of spatial relationships in an urban or regional context, and formulate a GIS approach to the question. In defining the project, the team is expected to explore the available data sets and to interview two or three key people in agencies relevant to their project. Each team is expected to produce and present a final project report.

Project Guidelines

Team Project Evaluation Breakdown
- Project Idea and Agency Interview 10%
- Draft Project Design and Revision 15%
- Status Report 10%
- Final Report 30%
- Presentation 20%
- Data Folder 15%

Sample Final Presentations (2014)
Sample Final Reports (2006 & 2007)

Grades

Grades are calculated as follows:
Lab Exercises: 25%
Mid-term exam: 25%
Team Project: 50%

Readings

All required readings will be accessible via the course website.
You are expected to read the required readings before lecture on the assigned day.

Materials

You will need a 2 Gig USB drive (preferably larger) to save your lab exercises and team project files.

Course Policies

Important policies to follow during lectures and labs:

No non-course computer work is permitted during lecture. Typing during a lecture can be very distracting to other students, and you are probably not getting much out of the session if you're working on a separate assignment or writing emails anyway.

It is the preference of the instructor that note taking be conducted on paper. Students are encouraged to take notes by hand during lectures. Research shows greater retention of material in students who make handwritten notes.

Turn your cell phone off. Period. Never answer calls or texts in class. If you have a situation where you absolutely cannot miss a phone call (medical emergencies, job interviews, etc), put your phone on vibrate, and please discuss it with the instructor and/or TA to let them know that you may answer a call and leave during class.

Keep talking to a bare minimum. During lab sessions it is acceptable to ask your neighbor questions, or to provide assistance if you see someone struggling and know how to help. General chatting, banter, and conversation are distracting. Especially for your instructor, who is old and easily distracted by extraneous activities during lectures. This will make him irritable.

Schedule

You can click on each lecture to see the powerpoint. To download several presentations, go to the lectures folder in the files section of the canvas site. Readings are summarized, for the full title go to the readings section of the Syllabus. (The undergraduate, 422 level is not required to read all the readings)
You can click on each exercise to link directly to the instructions and data.

Date & Topic	Lecture	Reading	In-Class Lab	Lab Due
Week 01				
01/06/14: Course Overview and Principles of GIS	Lecture 1	Smith et al (2015) Drummond and French (2008) Journal of the American Planning Association. Vol 74, Iss 2. What is GIS? Ch. 1,2,4. ESRI	Ex. 1	
01/08/14: Spatial Data Models and Structures	Lecture 2	Smith et al (2015) Longley, Ch. 3. Topology in ArcGIS Topology Rules Poster	Ex. 2 & 3	
Week 02				

01/13/14: Building a Geo-Database	Lecture 3	Smith et al (2015) Longley, Ch. 5. ESRI, What is GIS? Ch 3. *ESRI, Understanding Map Projections, Ch 1-3.*	Ex. 4	Ex.1 Schedule Project Interviews
01/15/14: Project Introduction	Lecture 4	Select two papers from the options in "choose two" folder. Ariely (2010) Predictably Irrational, Chapter 5.	Team Time I: team formation and topic selection	Ex. 2
Week 03				
01/20/14: Classifying the Urban Landscape	Lecture 5	Smith et al (2015) Powell et al. (2008). *Alberti, M., Weeks, R. and Coe, S (2004)*.	Ex. 5	Ex. 3
01/22/14: Describing the Urban Landscape	Lecture 6	Gustafson (1998) *Hahs and McDonnell (2006)*. *Wu, J. and David, J. (2002).*	Ex. 6	Ex. 4
Week 04				
01/27/14: Quantifying and Analyzing the Urban Landscape I: Vector Analysis	Lecture 7	Smith et al (2015)	Ex. 7	Team Project Idea & Interview Write-up
01/29/14: Urban Landscape Review Guest Speaker: Chad Lynch, Seattle DPD	Lecture 8	read **at least** one of the following articles: Galster et al 2001 Wolman et al 2005 Torrens 2008 Also read: Seattle Pedestrian Plan Executive Summary and Master Pedestrian Plan	Team Time II: CM design	Ex. 05
Week 05				

02/03/14: Quantifying and Analyzing the Urban Landscape II: Raster Analysis	Lecture 9	Smith et al (2015)	Project Review and Feedback Ex. 8 Ex. 8b(extra credit)	Ex. 6
02/05/14: Conceptual Models		Chrisman, Ch. 5	Team Time III: Team presentation and discussion of Conceptual Models	Ex. 7
Week 06				
02/10/14: Network Analysis	Lecture 10	Eckley and Curtin (2013) Evaluating the spatiotemporal clustering of traffic incidents. Computers, Environment and Urban Systems. Vol 37, pp 70-81.	Ex. 09 Team Time IV	Draft Project Design
02/12/14: Double Lab: one on one project design feedback	Project Feedback Comments	Grimm et al (2005). Turner, M. G. (1989). *Hargis etal (1998).*	Team Time V: Project Review and Feedback	Ex. 8
Week 07				
02/17/14: Midterm Review	Review		Team Time VI	Ex. 09
02/19/14: **Midterm**			Team Time VII	
Week 08				
02/24/14: Modeling Spatial Phenomena: Urban Landscapes and the Land Cover Change Model	Lecture 11	Smith et al (2015) Alberti, M.(1999). *Waddell, UrbanSim (2001).* *Hepinstall et al., (2008).*	Team Time VIII	Project Design Revisions
02/26/14: Watershed Delineation and Characterization Guest speaker: Peter Keum, King County	Lecture 12	Dozier et al 2009 Smith et al (2015) Longley & Batty (1996) Ch 2 and 3. Optional Reading:	Ex. 10	

DNRP/WTD/ETR		Beechie et al 2010		
Week 09				
03/03/14: Surface Analysis and Interpolation	Lecture 13	Smith et al (2015) Miller et al (2007)	Team Time IX	Project Status Report
03/05/14: Exploring Complexity, Uncertainty, and Error in the Urban Landscape	Lecture 14 Vertical Datums		Ex. 11	Ex. 10
Week 10				
03/10/14: Cost surfaces and distance analysis	Lecture 15	Burrough (1998) Ch. 9. *Longley, Ch. 6.*	Team Time X	
03/12/14		Team feedback form: Students, please download this form and use to take notes on any questions or constructive feedback you have for each team regarding their project. When you're done, upload them. What you write won't have any bearing on their grade (or yours). We'll pass these useful comments on to teams after the presentations on Thursday.	Project Presentations	Ex. 11
03/17/15: **Final Project - Reports Due by midnight**				Final Project

Lectures

Lecture 1: Course Overview and Principles of GIS

Course description, participation, and requirements
Introduction to spatial data, spatial concepts, and spatial analysis in planning

Lecture 2: Spatial Data Models and Structures

Representing the geometry of spatial phenomena
Raster and Vector data structures
Topology

Lecture 3: Building a Geo-Database

Features. Spatial relationships. Projection in more detail.

Lecture 4: Review of GIS Applications to Solve Spatial Problems

Functional approach to GIS to solve specific spatial problems

Lecture 5: Classifying the Urban Landscape

Classifying satellite image into land cover classes with spectral pattern recognition, spatial pattern recognition, and accuracy assessment of a classified map.

Lecture 6: Describing the Urban Landscape

Characterizing the urban landscape by describing its spatial and attribute properties.
Data sources
Function vs. structure
Boundary definition
Choosing a scale for analysis

Lecture 7: Quantifying and Analyzing the Urban Landscape I: Vector Analysis

Vector spatial analysis
Buffering and proximity analysis
Polygon overlays
Spatial clusters
Spatial modeling

Lecture 9: Quantifying and Analyzing the Urban Landscape II: Raster Analysis

Raster spatial analysis

Neighborhood functions, reclassification, spatial queries
Map algebra operations
Introduction to landscape pattern metrics

Lecture 10: Network Analysis

Basics of network analysis and Network Analyst
Example of optimal routing
Tip and tricks

Midterm Review and Vector vs. Raster Analysis

Review of Material so far.

Lecture 11: Modeling Spatial Phenomena: Urban Landscapes and the LCCM

Logit model conversions
Hedonic model of single housing sites
Biocomplexity Conceptual model
UrbanSim
The Land Cover Change Model

Lecture 12: Watershed Delineation

Digital elevation models
Terrain visualization and analysis
Basin delineation
Splines, Inverse Distance Weighting, Kriging, Spatial Statistics

Lecture 13: Surface Analysis and Interpolation

Spatial Unit, Scale, Impact of Measurement
Determining an Optimal Scale of Analysis

Lecture 14: Exploring Complexity, Uncertainty, and Error in the Urban Landscape

Registration error
Classification error
Accuracy assessments
Course Review

Exercises

Exercise 1: REVISITING GIS [Data gathering]

Objectives: Refresh memory about GIS usage.

- import files from various formats,
- learn some ArcMap functionality (table of contents, layout view, toolbars),
- use ArcCatalog to define a projection,
- create a simple jpeg of a map of your home

Download Instructions, Data, “Where to Find Data”, & “Toolbars”.

Exercise 2: Creating new maps with topology [Data gathering]

Objectives: Learn how to use the new ArcGIS 9 object oriented topology rules to create a topology feature dataset.

- To gain a better understanding of what topology is,
- Select new rules
- Inspect errors
- Fix errors

Download Instructions, Data, the Chaotic Kingdom, & Toplogy Rules

Exercise 3: Features, Feature Class, Coverages, Shapefiles, and Workspaces

Objectives: To test your understanding of different concepts such as coverages, shapefiles, features, feature class, and feature dataset.

Download Instructions & Data

Exercise 4: Processing vector data [Data processing]

Objectives: Use ArcMap to perform simple analytical procedures.

- use query,
- export
- spatial join,
- statistics

Download Instructions & Data

Exercise 5: Classifying Satellite Imagery [Data processing]

Objectives: Explore satellite bands, false color composites, areas of interest, reflectance graphs. Link aerial photography to images using IMAGINE. Create a signature file. Complete a supervised supervision.

Download Instructions & Data

Exercise 6. Using Fragstats to assess Landscape Metrics [Data Processing to Data Analysis]

Objectives: Reclassify landcover data set, Familiarize with fragstats gui, and Learn about landscape metrics.

Download Instructions, Data, & Definitions

Exercise 7: Buildable Land Inventory [Data Analysis]

Objectives: This exercise focuses on vector data analysis. Lessons include:

- Buffer
- Dissolve
- Union
- Join table

Download Instructions, Data, Example Flow chart, & Model Builder Example Instructions

Exercise 8: Park Selection using Spatial Analyst [Data Analysis]

Objectives: Learn how to use Spatial Analyst to conduct raster analysis and conduct a cost analysis for the best park location.

Download Instructions & Data

Exercise 8b :Advanced raster analysis

Objective: Provides you the opportunity to practice some more advanced raster analysis.

Download Instructions & Data

Exercise 09: Hydrology in the Urban Environment: Use DEM to analyze water flow within a sub-watershed.

Objectives: Use ArcGrid to look at flow direction, sinks, splitting, fill. Use Spatial Analyst for raster calculator, hillshade and basin mapping.

Instructions, Data, & Seademex9.zip

Exercise 10: Network analysis

In this exercise you will become familiar with the network analysis extension.

Download Instructions & Data

Exercise 11: Accuracy Using Kappa

Objective: In this exercise you will compare an aerial photo to a classified image in order to conduct an accuracy assessment.

Download Instructions & Data

Readings

Week One

01/06/15

1. de Smith, Goodchild, Longley (2015) Geospatial Analysis, Chapter 1, thru 1.4.1

2. Drummond and French (2008) Journal of the American Planning Association, vol. 74, iss 2.

3. ESRI, ArcGIS 9: What is ArcGIS, Chapters 1,2, and 4

01/08/15

1. de Smith, Goodchild, Longley (2015) Geospatial Analysis, Chapter 2

2. Longley, Goodchild, Maguire, and Rhind (2001). Geographic Information Systems and Science, Chapter 3

3. ESRI 10.2 Help Files on Topology in ArcGIS.

4. ESRI Topology Rules Poster

Week Two

01/13/15

1. de Smith, Goodchild, Longley (2015) Geospatial Analysis, Chapter 3, thru 3.3.5

2. Longley, Goodchild, Maguire, and Rhind (2001). Geographic Information Systems and Science, Chapter 5.

3. ESRI, ArcGIS 10.2.2 Help Files, An overview of the Geodatabase (do not read tutorial)

4. ESRI (2004). Understanding Map Projections. Chapters 1-3. (Optional)

01/15/15

1. Ariely (2010) Predictably Irrational, Chapter 5.

Select two papers from the following list:

Aultman-Hall, L. Roorda, M. and B. W. Baetz (1997) Using GIS for evaluation of neighborhood pedestrian accessibility. Journal of Urban Planning And Development. 123(1):10-17.

Baker & Wiley (2001) GIS-based hydrologic modeling of riparian areas: Implications for stream water quality. Journal of the American Water Resources Association 37(6): 1615-1628

Fisher, J.B., Kelly, N.M., Romm, J. (2006) Scales of environmental justice: Combining GIS and spatial data analysis for air toxics in West Oakland, California. Health & Place (in press)

Luck, M. and Wu J. (2002) A gradient analysis of urban landscape pattern: a case study from the Phoenix metropolitan region, Arizona, USA. Landscape Ecology, (17)327-339.

Russell, G.D., Hawkins, C.P. and M.P. O'Neill (1997) The role of GIS in selecting sites for riparian restoration based on hydrology and land use. Restoration Ecology, 5(4):56-68.

Srinivasan S. and J. and Ferreira (2002) Travel behavior at the household level: understanding linkages with residential choice. Transportation Research Part D (7): 225–242.

Tian, J. L., Erickson, L. J. and T. D. Dulikowski (1998). Analyzing growth-management policies with geographical information systems. Environment and Planning B, 25(6):865-879.

Week Three

01/20/15

1. de Smith, Goodchild, Longley (2015) Geospatial Analysis, Section 4.2.12

2. Powell, Cohen, Yang, Pierce, and Alberti (2008) Quantification of impervious surface in the Snohomish Water Resources Inventory Area of Wester Washington from 1972-2006. Remote Sensing of Environment (112): 1895-1908.

3. Alberti, M., Weeks, R. and Coe, S (2004). Urban land cover change analysis in the Central Puget Sound region. (optional)

01/22/15

1. Gustafson (1998) Quantifying landscape spatial pattern: What is the state of the art? Ecosystem 1(2): 143-156

2. Hahs and McDonnell (2006) Selecting independent measures to quantify Melbourne's urban-rural gradient. Landscape and Urban Planning(78):435-448 (optional)

3. Wu, J. and David, J. (2002) A spatially explicit hierarchical approach to modeling complex

ecological systems: theory and applications. Ecological Modeling (153):7-26 (optional)

Week Four

01/27/15

1. de Smith, Goodchild, Longley (2015) Geospatial Analysis, Chapter 4 thru 4.2.11 & 4.3 thru 4.4

01/29/15

Read One:

1. Galster, Hanson, Ratcliffe, Wolman, Coleman, and Freihage (2001), Wrestling Sprawl to the Ground: Defining and measuing an elusive concept. Housing Policy Debate (12):681-717

2. Torrens (2008), A toolkit for measuring sprawl. Applied Statistical Analysis (1):5-36

3. Wolman, Galster, Hanson, Ratcliffe, Furdell, and Sarzynski (2005), The fundamental challenge in measuring sprawl: which land should be considered? The Professional Geographer (57:1):94-105

Guest Speaker Readings

1. Seattle Pedestrian Master Plan Executive Summary

2. Seattle Pedestrian Master Plan

Week Five

02/03/15

1. de Smith, Goodchild, Longley (2015) Geospatial Analysis, 4.5 thru 4.6.3 & Chapter 5 thru 5.4

2/05/15

1. Chrisman, N (1997). Exploring Geographc Information Systems. J. Wiley. Chapter 5.

Week Six

02/10/15

1. Eckley and Curtin (2013) Evaluating the spatiotemporal clustering of traffic incidents. COmputers, Environment and Urban Systems. Vol 37, pp 70-81.

02/12/13

1. Grimm V, Revilla E, Berger U, Jeltsch F, Mooij WM, Railsback SF, Thulke H-H, Weiner J, Wiegand T, DeAngelis DL. (2005) Pattern-oriented modeling of agent-based complex systems: lessons from ecology. Science 310, 987-991.

2. Turner, M. G. (1989). Landscape Ecology: The Effect of Pattern on Process. Annual Review Ecological Systems 20, 171-197.

3. Hargis, C. D., Bissonette, J. A. and J. L. David (1998). The Behavior of Landscape Metrics Commonly Used in the Study of Habitat Fragmentation. Landscape Ecology 13, 167-186. (optional)

Week Eight

02/24/13

1. de Smith, Goodchild, Longley (2015) Geospatial Analysis, Chapter 8 thru 8.2

2.Alberti, M.(1999) Modeling the urban ecosystem: a conceptual framework. Environment and Planning B: Planning and Design (26)605-630.

3. UrbanSim: Modeling Urban Development for Land Use, Transportation and Environmental Planning, Paul Waddell, September 2001. (optional)

4. Hepinstall et al., (2008) Predicting land cover change and avian community responses in rapidly urbanizing environments. (optional)

02/26/15

1. de Smith, Goodchild, Longley (2015), Geospatial Analysis, sections 5.5 & 5.6

2. Longley & Batty (1996), Spatial Analysis: Modelling in a GIS Environment, Chapters 2 & 3

3. Dozier and Gail (2009), The emerging science of environmental applications. The Fourth Paradigm, Chapter 4.

4. Beechie, Sear, Olden, Pess, Buffington, Moir, Roni, and Pollock (2010), Process-based principles for restoring river ecosystems. Bioscience (60:3):209-222

Week Nine

03/03/15

1. de Smith, Goodchild, Longley (2015) Geospatial Analysis, Chapter 6 thru 6.6.14

2. Miller, S. N., Semmens, D. J., Goodrich, D. C., Hernandez, M., Miller, R. C., Kepner, W. G., and Guertin, D. P. (2007) The Automated Geospatial Watershed Assessment tool. Environmental Modelling & Software.

Week ten

03/10/15

1. Burrough, P.A. and R.A. McDonnell (1998). Chapter 9.

2. Longley, Goodchild, Maguire, and Rhind (2001). Geographic Information Systems and Science, Chapter 6. (optional)