GIS Modeling Class Syllabus

…an introduction to grid-based map analysis and modeling

GEOG 3110, University of Denver, Geography, Winter Term 2013
Thursdays 6:00-9:15 pm, GIS Lab, Room 126, Boettcher (West)

<***Click here*** *>for a printer-friendly version of this Syllabus*
<***Click here***> *for 1-page flyer describing the course*

<***Class website*** *is posted at* http://www.innovativegis.com/basis/Courses/GMcourse13/>
<*This* ***Syllabus*** *is posted at* http://www.innovativegis.com/basis/Courses/GMcourse13/Syllabus/>

Instructor: Joseph K. Berry, Room 213 Boettcher West, phone 970-215-0825

About the instructor: http://www.innovativegis.com/basis/basis/cv_berry.htm

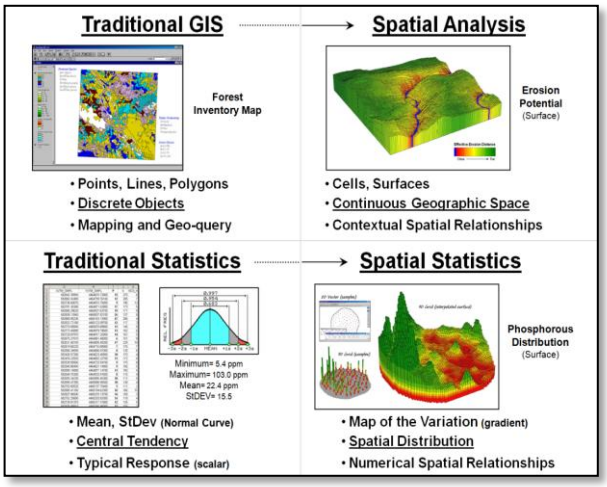
Email: jkberry@du.edu or jberry@innovativegis.com – Website: www.innovativegis.com/basis

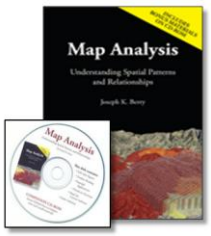
Open Door office hours are Thursdays, 3:00 to 5:00pm (or specially arranged on Thursdays)

Course Materials:

- **Course Text** is *Map Analysis: Understanding Spatial Patterns and Relationships* (Berry, 2007) available at an **author's discount** at the first class meeting ($34.64) or you can order from www.geoplace.com/books/mapanalysis for $51.95, includes U.S shipping. The book includes a ***Companion CD*** including software Further Readings, Example Applications, Software and Exercises…
  http://www.innovativegis.com/basis/Books/MapAnalysis/
- **Course Materials** including lecture notes, exercises and readings are posted on the ***Class Website*** at…
  http://www.innovativegis.com/basis/Courses/GMcourse13/

Course Description:





This intermediate course focuses on the concepts and procedures used in discovering and applying the spatial relationships within and among maps. It extends the mapping and geo-query capabilities of GIS technology to map analysis and construction of spatial models. The course establishes a comprehensive framework that addresses a wide range of applications from natural resources to geo-business — *within "a map-ematical structure."*

Topics include the *Nature of Mapped Data*, *Spatial Analysis* and *GIS Modeling* in the first six weeks followed by *Surface Modeling* and *Spatial Data Mining* operations in the ensuing four weeks. The lectures, discussions and homework/lab exercises provide a foundation for creative application of GIS technology in spatial reasoning and decision-making — *"thinking with maps."*

The course uses Dr. Berry's book *Map Analysis: Understanding Spatial Patterns and Relationships* (GeoTec Media, 2007).

See www.innovativegis.com/basis/Books/MapAnalysis/ for more information about the book

Application areas addressed in the course include Natural Resources *(Habitat Mapping, Wildfire Risk, Visual Exposure Impacts, Accessibility),* Precision Agriculture *(Soil Nutrient Mapping, Yield Analysis, Fertility Program Optimization, Erosion Potential),* Infrastructure *(Routing and Optimal Paths, Risk Analysis, Consensus Building),* Geo-Business *(Store*

Siting, Competition Analysis, Retail sales Forecasting, Commercial Properties Investment) and numerous other examples that draw on the instructor's consulting, presentations and research projects.

Course Objectives:

Students will develop spatial reasoning skills necessary in conceptualizing, flowcharting and implementing GIS solutions. The understanding of grid-based analytical operations and fundamental approaches used in descriptive, predictive and prescriptive mapping extends existing courses in data encoding, management and software usage. Students who are most successful in this course will be able to demonstrate:

- ✓ an understanding of the differences between data processing in discrete and continuous space
- ✓ an awareness of spatial dependency within and among mapped data and its effect on map analysis
- ✓ a working knowledge of basic spatial interpolation and statistics procedures
- ✓ a working knowledge of grid-based spatial analysis operations to include visual analysis, effective distance, optimal path density, terrain analysis, contextual summaries and edge/shape/pattern characterization, and
- ✓ an ability to conceptualize, flowchart and implement GIS models.

Topics and Schedule:

Week	Topic
1 1/10	**Overview**: GIS mapping, management and modeling; Discrete (map objects) vs. continuous (map surfaces); Linking data and geographic distributions; Framework for map-*ematical* processing URL links to *Reading Assignment* are posted on the Class Website at… ***http://www.innovativegis.com/basis/Courses/GMcourse13/*** **Map Analysis** book sections — **Foreword**, **Preface, Introduction** and **Table of Contents** **Online Papers** — "**Making a Case for SpatialSTEM**" and "**An Analytical Framework for GIS Modeling**"
2 1/17	**Maps as Data:** Map data types and their implications; Contouring and thematic mapping effects/implications; Vector vs. Raster; Raster images, grids and pseudo-grids
3 1/24	**Reclassifying and Overlaying Data Layers:** Characterizing size, shape, pattern and arrangement; Point, region and map-wide overlay; Grid math; Spatial coincidence statistics; Comparing maps; Error propagation
4 1/31	**Measuring Distance and Connectivity:** Simple vs. effective distance; Proximity and movement; Accumulation surfaces; Identifying optimal path(s); Viewsheds and visual exposure surfaces; Narrowness surfaces
5 2/7	**Summarizing Spatial Context:** Calculating slope, aspect and profile maps; Applying spatial differentiation and integration; Roving window summary operations; Characterizing edges and complexity
6 2/14	**GIS Modeling Approaches:** Deductive vs. inductive reasoning; Flowcharting spatial problems; Types of GIS models ***** online Exam #1 — covers week 1-5 material *****
7 2/21	**GIS Modeling Examples:** Pipeline routing; Wildfire risk mapping; Micro-terrain analysis; Retail sales prediction
8 2/28	**Surface Modeling:** Basic statistics and its GIS expression; Spatial dependency; Spatial interpolation (IDW, Kriging and others); Assessing interpolation results; Mapping spatial dependency; Sampling design
9 3/7	**Spatial Data Mining:** Linking numeric and geographic patterns; Normalizing maps; Viewing scatter plots; Clustering mapped data; Investigating map correlation; Developing prediction models; Assessing prediction results
10 3/14	**Future Directions:** Dynamic map pedigree; Toward a humane GIS; GIS software's changing roles; Evolving the GIS mindset; Is technology ahead of science?; Multimedia Mapping; Map Display
Finals Week	***** online Exam #2 — covers weeks 6-10 material ***** ***** Grad Student Presentations during scheduled Final Exam period *****

Prerequisites:

An introductory course in GIS (recommended) or instructor permission is required for enrollment. Familiarity with basic statistical concepts, general computer skills and interest in quantitative analysis are helpful.

Course Format:

The class meets once a week for three hours with a 15 minute midway break. Class meetings involve lecture, discussion and real-time demonstrations of concepts in spatial analysis, spatial statistics and GIS modeling using *MapCalc* and *Surfer* software. Student teams will complete homework/lab exercises (approximately six hours per week) outside of class using Geography GIS Lab facilities or software installed on student's personal computer. The *MapCalc* and *Surfer* operations used in the exercises are cross-referenced to the *Spatial Analyst* module of the ArcGIS commercial software system. Students are expected to remain current on reading assignments (approximately two hours per week) and be prepared to contribute to class discussion.

Guidelines for Preparing Homework Assignments

Homework/lab assignments use course software to address a series of questions that demonstrate GIS modeling concepts, procedures, considerations, applications and issues. The questions form a *Word* template for the lab report you will prepare as teams. You are encouraged to use screen captured images and embed them as figures that structure your answer. Your responses should be as succinct as possible while developing clear and complete answers to the questions. Be sure to use Spelling and Grammar checkers in *Word* and adhere to business report formatting as outlined in the online Class Syllabus Report Writing Tips item. A high degree of professionalism in preparing your homework/lab and mini-project reports is expected.

The homework/lab and mini-project assignments will be completed in two to four member teams. To help keep track, please name your homework files with the exercise number followed by the team member names separated by an underscore (e.g., **Exercise0_Berry_Smith_Jones.doc**). The extension "_graded" will be added when the assignment is graded and returned to each of the members on the team.

The homework/lab exercises represent over half of your grade (7 Lab reports plus 1 Project report = 350 + 150= 500 of 900 total points). One of the seven weekly homework/lab reports can be skipped (student discretion; grade will be determined as the overall average of other homework exercises). Students can choose to substitute an individual report (10-15 pages) on any GIS modeling related topic of their choice for either of the last two lab reports.

In addition to normal course requirements of participation, homework/lab reports, mini-project and exams, **graduate students** are required to submit a short paper and oral presentation on how they believe they will use the material learned in this course in their academic research (thesis students) or anticipated professional work environment (non-thesis students). The paper and presentation are due during the scheduled Final Exam period for the course.

Submitting Homework Assignments

Homework assignments are **due by 12:00 midnight the following Thursday night** (7 days to complete). This provides an opportunity to address questions via email and during the instructor's office hours. If more time is needed, email a request for an extension **before class** specifying a new due date/time.

Submission and Grading: Store your completed exercises as *Word* documents (*.doc* file) and email the group's report directly to me (jberry@innovative.com). All exchange of the labs will be in electronic **Web Layout View** format. The document will returned the following week with grading comments, team evaluation and overall grade.

Method of Evaluation:

Grades for the course will be determined as follows:

	Undergraduate Students	Graduate Students
Teammate Evaluations (7 labs * 10 points + 1 mini-project of 30 points)	**100**	**100**
Homework Exercises (7 assignments worth 50 points each)	**350**	**350**
GIS Modeling Project (Week 7)	**150**	**150**
Exam 1 (taken online during Week 6)	**150**	**150**
Exam 2 (taken online during Finals week)	**150**	**150**
Graduate Student Paper and Presentation (scheduled Final Exam period)	**--**	**100**
Total Points	**900**	**1000**

Note: Up to **100 Optional/Extra Credit Points** are available for students wanting to pursue a topic in greater detail or increase their grade. Points earned are cumulative and translate into a letter grade according to the following scale:

A+ 97-100%, **A** 93-97%, **A-** 90-93%, **B+** 87-90%, **B** 83-87%, **B-** 80-83%, **C+** 77-80%,
C 73-77%, **C-** 70-73%, **D+** 67-70%, **D** 63-67%, **D-** 60-63%, **F** 0-60% (tie point goes to the student)

Policies and Expectations:

Students are expected to attend class regularly. Class lectures, discussion and demonstrations are an important part of the course that is difficult to reconstruct. Excused absences include illness, death in the family or participation in a DU sanctioned event. If you must miss class, please notify the instructor **prior** to the class meeting so arrangements for makeup of the material missed can be made.

Unexcused late homework assignments without prior notification receive a maximum possible of 45 points (10% penalty) if turned in before to the next class meeting and will not be accepted (0 points) if more than one week late. There are no make-up exams except for excused absences with prior notification. Students may review their current grade at anytime during office hours; periodic summaries will be emailed.

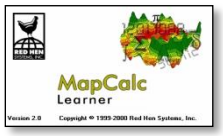
Course Software

All of the course software is installed on the GIS Lab computers. You can install the software to your own computer from the Map Analysis book's companion CD or download from the Internet—

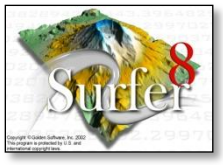
Microsoft Office [you need to have working versions of Microsoft Office applications *Word*, *PowerPoint* and *Excel* loaded on your computer]

Adobe Reader [**download** and **install** from the Internet — Windows-based program for viewing/printing documentation files (.pdf); free software; see www.adobe.com/products/acrobat/readstep2.html for more information on Adobe Reader and free download]

SnagIt [**download and install** from the Internet — screen capture software; 30 day evaluation; see www.techsmith.com/ for information on fully licensed system ($37.95 Academic version)]



MapCalc Learner [install from the Map Analysis book **Companion CD** or download from www.innovativegis.com — grid-based map analysis software included with the course materials provided by the instructor]



Surfer Demo [install the demo **Version 8** software from the Map Analysis book **Companion CD** — surface modeling and 3D display software included with the course materials provided by the instructor; also you can download the most recent version from www.goldensoftware.com/demo.shtml but the exercises in the course may not directly correspond; see www.goldensoftware.com and select "Products→ Surfer" for more information on fully licensed system ($699)]

_____