

Florida International University, Department of Earth and Environment

GIS and Spatial Analysis for Earth Scientists (3)

GLY 5758, Fall Term 2009

T/Th 5:00 – 6:15

GISRSAL Lab, GL 274

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Office Hours: W/Th: 2-4PM in PC325,
Th: after class in GL274 or by appointment

Course Syllabus

The material below contains important information for this course. Please read this material and retain this document for future reference.

Course Description:

Spatial analysis is a set of techniques for analyzing patterns of and interrelationships between map data. The field of spatial analysis has seen much growth in recent years with the introduction of inexpensive and easy to use Geographic Information Systems (GIS). While many users employ GIS only for building spatial databases and displaying maps, GIS are powerful tools for performing spatial analysis. This course will introduce advanced undergraduates and graduate students to techniques for using GIS technology to solve problems in the earth and environmental sciences. Emphasis in this course will be on applying raster analysis techniques.

The course will be comprised of lectures and computer exercises. Computer instruction will utilize the GIS laboratory in the FIU Library. Course will be composed of 1) Review of GIS concepts and data models; 2) concepts of spatial statistics; 3) methods of spatial analysis including density mapping, buffer zone analysis, surface estimation, geostatistics, map algebra, and suitability modeling.

Course Objectives/Learning Outcomes:

Students completing this course will have a strong understanding of the theory of and the basic functions used in GIS raster analysis and modeling. Students will have a functional understanding of the Spatial Analyst and Geostatistical Analyst extensions for ArcGIS 9.3.

Software:

Most examples and exercises will utilize ESRI's ArcGIS V. 9.3 with the Spatial Analyst, Geostatistical Analyst and 3-D Analyst extensions. **Please note:** The demo software DVD included with *Getting to Know ArcGIS Desktop* does not include any of the advanced extensions and cannot be used to do any of the computer exercises in this course. These exercises must be done either in the GIS Lab (GL274) or in a remote lab that has a full installation of ARCGIS 9.3. Additional numerical analysis will use Microsoft Excel.

Prerequisites and Recommended Background:

An introductory GIS course (*GIS 5050 or equivalent*) or previous experience with ArcGIS is strongly recommended. It is **required** that students without previous experience with ArcGIS purchase the *Getting to Know ArcGIS Desktop* workbook and do the exercises during the first 2 weeks of the course. **Please note:** See the note in the section above regarding the limitations of the software CD included with this book. .

Basic analytic geometry, trigonometry, and statistics is recommended. Competence with personal computers and application software is essential.

Grading:

Course grade will be based on attendance and class participation (15%), exercises (50%), a Midterm Exam (15%), and a Final Exam (20%). Exams will be closed book and will test your understanding of concepts covered in class, not skill in operating software.

Required Reading:

The following text is available free online at www.spatialanalysisonline.com. A hardcopy version may also be purchased from the publisher (students can receive a discount)

1. M. J. de Smith, M.F. Goodchild, and P. A. Longley, *Geospatial Analysis, A Comprehensive Guide to Principles, Techniques and Software Tools, 3rd Ed.*, Matador (an imprint of Troubador Publishing Ltd), 2009.

The following 3 books contain readings for the course. Students may either purchase the books on their own or check out the book for the 2 hour reserve desk on the 2nd floor of the library.

2. G. F. Bonham-Carter, *Geographic Information Systems for Geoscientists*, Pergamon, 1994.
(Call number: G70.2.B66 1994)
3. M. N. DeMers, *GIS Modeling in Raster*, John Wiley & Sons, 2002.
(Call Number: G70.212.D47 2002)
4. T. C. Bailey and A. C. Gatrell, *Interactive Spatial Data Analysis*, Longman, 1995
(Call Number:QA278.2.B35 1995)

The books below are ArcGIS Extension Workbooks. They may be purchased on-line from ESRI press for \$39.95 each, at: <http://gisstore.esri.com/> (click on *ArcGIS Documentation*). * Electronic versions (PDF) of these books are available on the GIS Lab Public server in folder:

P: /ArcGIS9_Manuals/ESRI_Library/ArcGIS_Extensions/

5. *Using ArcGISTM Spatial Analyst*, J. McCoy and K. Johnston, ESRI Press, ISBN: 1-58948-105-4, 233 pages, ESRI 2004.
6. *Using ArcGISTM Geostatistical Analyst*, K. Johnston, J.M. Ver Hoef, K. Krivoruchko, and N. Lucas, ESRI Press, ISBN: 1-58948-106-2, 300 pages, ESRI 2004.

Recommended Reading for GIS Rookies:

(Available in Campus Bookstore and from the ESRI web site: <http://gisstore.esri.com/>)

1. *Getting to Know ArcGIS Desktop 2nd Ed., Updated for ArcGIS9.3 (GTKAD)*, T. Ormsby and others, ESRI Press, ISBN: 9781589482104 , 2008 620 pages, \$79.95. Note: this book is

required for students without ArcGIS experience. Datasets and materials used with this book are available on public drive in: **P: /ArcGIS9_GTK/**

University Policy on Academic Misconduct

Florida International University is a community dedicated to generating and imparting knowledge through excellent teaching and research, the rigorous and respectful exchange of ideas, and community service. All students should respect the right of others to have an equitable opportunity to learn and honestly to demonstrate the quality of their learning. Therefore, all students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational mission of the University. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook.

Course Outline and Reading Assignments (Tentative):

Weeks 1:	Organization. GIS Lab orientation. Maps as models. GIS data types, and structures. Vector and raster data models
Reading:	de Smith et.al: Ch 1-2; Bonham-Carter: Ch. 1 -3; DeMers, Ch 1
Week 2	What is spatial analysis? Modeling of spatial data. Review of raster analysis functions. Working with Raster Data Models; The ESRI Grid model
Reading:	de Smith et.al: Ch 3; McCoy & Johnston, Ch 1 – 3, 6; DeMers, Ch 3; Johnston et al., Ch 1,2, 4
Exercise 1:	Getting Started with ArcGIS Spatial Analyst
Week 3	Resampling, transforming, and registering Grids Geometric Transformations of Grids
Reading :	Bonham-Carter: Ch 4; DeMers, Ch. 2; McCoy & Johnston, Ch 4 - 5
Exercise 2:	Grid Import, Resampling, and Registration, Using the Raster Calculator
Week 4:	Vector to raster; point and lines to areas.
Reading:	Bonham-Carter: Ch 6; McCoy & Johnston, Ch 7
Exercise 3:	Vector to raster transformations. Fractal dimension of a coastline.
Week 5 & 6:	Point and line distributions. Measurements of spatial form. Randomness, clustering, regularity and anisotropy.
Reading:	de Smith et.al: Chs 4.34, 5.1-5.4; Bonham-Carter: Ch 6; Bailey and Gatrell, Ch 3.
Exercise 4:	Density maps, buffer maps, point to area conversions. Analysis of point patterns.
Week 7:	Midterm Quiz

Week 8: Estimating surfaces; the art of computer interpolation gridding, and interpolation. TIN, IDW, trend surfaces, kriging.
 Reading: **de Smith et.al:** Ch 6.6; **Bonham-Carter:** Ch 6; **Bailey and Gatrell,** Ch 5&6.; **Johnston et al.,** Ch 3, 5, 6; **McCoy & Johnston,** Ch 7
 Exercise 5: Modeling of Surfaces I: Deterministic Methods-IDW, Splines, TIN

Week 9 & 10: Optimal estimation of surfaces, geostastics, kriging.
 Reading: **de Smith et.al:** Ch 6.7; **Bonham-Carter:** Ch 6; **Bailey and Gatrell,** Ch 5&6.; **Johnston et al.,** Ch 3, 5, 6; **McCoy & Johnston,** Ch 7
 Exercise 6: Modeling of Surfaces II: Variograms, Geostatistics and Kriging

Week 11: Univariate analysis of surfaces and raster maps. Reclassification, filtering and image processing. Local, zonal, and focal functions.
 Reading: **de Smith et.al:** Ch 4.6; **Bonham-Carter:** Ch 7; **DeMers,** Ch 4; **McCoy & Johnston,** Ch 7

Week 12: Analysis of map pairs. Spatial association analysis. Cross area tabulation.
 Reading: **Bonham-Carter:** Ch 8
 Exercise 7: Two map association with cross tabulation

Week 13: Analysis of two or more coincident maps. Map algebra. Cluster analysis. Regression Modeling; Inter-map relationships.
 Reading: **de Smith et. al:** Ch 5.6; **Bonham-Carter:** Ch 8 & 9; **McCoy & Johnston,** Ch 7, App 1
 Exercise/Demo: Spatial regression models

Week 14 & 15 Suitability modeling.
 Reading: **DeMers,** Ch 5-7; **McCoy & Johnston,** Ch 1-3 (again!); ESRI Documentation
 Exercise 8: Suitability and Hazard Modeling

Finals Week: Final Exam