

Syllabus

GIS200-Fundamentals of Geostatistics and GIS

(Six units)

Summer 2011 (June 12 – July 15, 2011)

Instructor: Dr. Zhi (Luke) Wang

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Basic Course Information

This is a 6-unit course (equivalent to 10 lecture-hours and at least 15 lab-hours per week) to be learned during the offering period only. Thus it is very time- and nerve-consuming, be prepared! The course materials are available from the instructor and the College of Hydraulic and Construction Engineering at Northwest A & F University of China.

Information for the entire class will be posted weekly, or more often if necessary. For personal questions, email or telephone the Teaching Assistants (TAs) or the instructor. When writing an E-mail to the instructor, be sure to write “*GIS200-LastName-Initial-lab# or question*” (no space anywhere) in the subject line, otherwise the email will be deleted as junk mail.

Course Description

This course teaches Geostatistics and Geographic Information Systems (GIS) concepts and techniques with special skills on spatial information management, analysis, interpretation, map generation and display using advanced geostatistics and GIS software packages. Specific contents include geostatistical assessment of spatial data, map generation and computerization using vector and raster data models; coordinate systems conversion and geometric transformation; spatial data editing, management and exploration; terrain mapping and analysis with applications in generating viewsheds and watersheds; spatial interpolation; geo-coding and GIS modeling, etc.

Prerequisite

While there are no specific prerequisites, this course is primarily for:

- Bachelor’s degree holders and equivalent professionals who did not have chances to learn geostatistics and GIS but need to use them now as needed or required in many professions
- Master’s or Ph. D. candidates or degree holders who want to use GIS for enhancing research, employability and continued education in science and computer applications.
- Any other matriculated persons who have desirable backgrounds in basic science and computer applications (including but not limited to environmental studies and sciences, geosciences, biosciences, physical sciences, engineering, social and economic sciences, etc.), familiar with database and spreadsheet software packages (such as dBase, Access and Excel etc.).

Expected Learning Outcomes

The goal of this course is to gain a basic and practical understanding of the geostatistical and GIS operating systems, technical issues and applications in various professions. Upon the completion of this course the students will be able to:

1. Compile, categorize and combine GIS and geostatistical tools, concepts, data and models to solve in-situ environmental problems. This includes identifying the scientific and application needs, data acquisition and analysis, and report writing at the professional level. Students in this course are required to complete two self-proposed GIS and geostatistical projects which will require synthesis and evaluation.
2. Create, devise, restructure and relate various data components such as maps, tables, digital documents, air photos, drawings, geological and geographic data etc. to produce mapping results of the combined GIS and geostatistical analyses. This is applied in the midterm project on water uses by US counties.
3. Critique the values of proposed ideas, materials and the GIS-geostat assessment results for decision making. This is learned through the term project proposal and its execution.
4. Resolve issues involved in choosing a suitable GIS and geostat analysis procedure and toolset for the project; organize data and modify various map projections for the project purposes; expertly apply ArcCatalog and Toolboxes in ArcGIS; properly choose, convert and align various coordinate systems in the GIS project.
5. Integrate data, vector and raster models, and convert from one to another.
6. Create and integrate GIS spatial data and demographic data from various sources to explore social, demographic, scientific, engineering, political and economic conditions of a given system.
7. Delineate temporal and spatial distribution of human resources, economic status, natural resources and hazards etc. in a given geographic region.
8. Create and conduct hypothesis or scenario testing; compare, evaluate and critique input data; interpret the results; summarize, conclude and produce recommendations on results.
9. Disseminate results through reports, publications, presentations and/or other outlets.

Textbooks

GIS: K-T Chang, *Introduction to Geographic Information Systems*, 5th edition. McGraw Hill Higher Education, 2010 (ISBN 978-0-07-352283-8).

Geostatistics: Instructor lecture notes (available online)

Bases for Course Grade

Assignment	Weight
Lecture Attendance	10%
Lab exercises	80%
Midterm project	10%
Term project	00%
Total	100%

Letter grade	Percentage
A	90% or higher
B	80% or higher
C	70% or higher
D	60% or higher
F	Lower than 60%

Lecture Attendance:

Attendance to lecture sessions is required (beneficial to oneself and others) and will be counted by the signature on the attendance sheet.

Lab Exercises:

There are up to 30 hands-on lab exercises for you to learn the methods/techniques step-by-step. In each lab, you need to follow the instructions provided, write your answers and analysis in a Word file, and copy and paste the software screen-shots in proper places of the Word file. Save the Word file then print it

as a PDF file for submission. The PDF file should be named as GIS200-LastName-FirstName-Lab#, otherwise it will not be accepted. These lab exercises will generally be due by 5 pm Friday of the assignment week. Each lab counts for 5 points. Later labs submitted after the deadline will lose 0.5 point (10%) per day of delay. Late labs will affect your learning of the following Chpters that will use the earlier concepts.

Midterm Project:

The instructor assigns a midterm project on regression analysis and water uses per county in the United States. There are various uses for fresh, salty, surface and ground waters. Students will choose certain uses of the water resources and conduct vector type of analyses. The results including a written report and all map and document files will be submitted to the instructor and TAs for grading. The submitted ArcMap files should be able to display properly in another computer, otherwise, 1/10th of the midterm grade will be deducted.

Term Project (not available for this course due to time limits):

You will need to propose a term project to complete in this course. The instructor will help you define a geographic region and the problem of interest during the last few weeks. You will then try to obtain and create various datasets for the *project area*. You will apply almost all the GIS and geostatistical techniques learned in the course for your research in the specific project. You are required to submit a comprehensive project report. A detailed “**Lab and Term Project Guideline**” is attached to the end of this syllabus.

Hardware and Software Requirements

Each student must have access to a computer which is capable of running MS Windows-based software. The minimum system requirements are:

- Operating system: Windows 2000 professional or higher
- CPU Speed: 1.6 GHz or higher
- Memory (RAM): 1 GB
- Free Disk Space: 5 GB
- ArcGIS Desktop with Spatial Analyst, 3D analyst, Network Analyst, and Geostatistical Analyst is needed to complete the course.

E-mail Rules

- Login to your e-mail account. The e-mail should be sent to ? (to be decided in the first class)
- In the “Attachment” line, attach your PDF file (one lab per e-mail).
- In the “SUBJECT” line of your e-mail, type “**GIS200-YourLastName-FirstName-Lab#**” (e.g., **GIS200-Smith-John-Lab1, GIS200-Smith-John-ProjectReport**). *If you do it EXACTLY, your homework will go directly to the designated mail box for this course, otherwise it may get lost.* Thanks for your corporation!!
- Click on “send” button and wait until the e-mail is sent out.

GIS200-Fundamentals of Geostatistics and GIS Tentative schedule

Day	Date	Geostatistics 9-10 am	GIS 10-11 am Labs are due by 5 pm Friday
1	6/14/2011 Tuesday	Intro to Geostatistics G-Lab1: Excel data and skills	<i>Intro to GIS (Chp 1)</i> GIS-Lab1: Chp 1, Tasks 1 and 2
2	6/15 W	Descriptive statistics	Chp2: Coordinate Systems GIS-Lab2: Chp 2, Tasks 1-4
3	6/16 Th	Descriptive statistics	Chp3: Vector Data Model GIS-Lab3: Chp 3, Tasks 1-6
4	6/17 F	Descriptive statistics G-Lab2 – Descriptive stat, Histogram	Chp4: Raster Data Model GIS-Lab4: Chp 4, Tasks 1-3. Labs are due by 5 pm
5	6/18	Saturday no class	Saturday no class
6	6/19	Sunday no class	Sunday no class
7	6/20 M	Graphical analysis (MiniTab 11) G-Lab3 – Graphical Statistics	Chp5: GIS Data Acquisition GIS-Lab5: Chp 5, Tasks 1-3
8	6/21 Tu	The Normal distribution	Chp6: Geometric Transformation GIS-Lab6: Chp 6, Tasks 1-3
9	6/22 W	The standard normal distribution G-Lab4 – Normal distribution	Chp7: Spatial Data Editing GIS-Lab7: Chp 7, Tasks 1-5
10	6/23 Th	t distributions G-Lab5 – t-test	Chp8: Attribute Data Input and Management GIS-Lab8: Chp 8, Tasks 1-6
11	6/24 F	Hypothesis testing	Chp9: Data Display and Cartography GIS-Lab9: Chp 9, Tasks 1-3, Labs are due by 5 pm
12	6/25	Saturday no class	Saturday no class
13	6/26	Sunday no class	Sunday no class
14	6/27 M	Correlation and Regression G-Lab6 – regression	Chp10: Data Exploration GIS-Lab10: Chp 10, Tasks 1-3

15	6/28 Tu	Multiple regression Lab 7 – multiple regression	Chp11: Vector Data Analysis GIS-Lab11: Chp 11, Tasks 1-3
16	6/29 W	Start G Midterm project	Start GIS Mid-term project
17	6/30 Th	Work on G Mid-Term project	Work on GIS Mid-Term project
18	7/1 F	Submit G Mid-Term project report by 5 pm Friday	Submit Mid-Term project report by 5 pm Friday
19	7/2	Saturday no class	Saturday no class
20	7/3	Sunday no class	Sunday no class
21	7/4 M	Auto correlation G-Lab8 - Auto correlation	Chp12: Raster Data Analysis GIS-Lab12: Chp 12, Tasks 1-5
22	7/5 Tu	Cross correlation G-Lab9 - Cross correlation	Chp13: Terrain Mapping and Analysis GIS-Lab13: Chp 13, Tasks 1-3
23	7/6 W	Semivarigrams + GS plus G-Lab10 – Semi varigrams	Chp14: Viewsheds and Watersheds GIS-Lab14: Chp 14-Tasks 1-4
24	7/7 Th	Instructor not available	Instructor not available
25	7/8 F	Instructor not available	Instructor not available
26	7/9	Saturday no class	Saturday no class
27	7/10	Sunday no class	Sunday no class
28	7/11 M	Interpolation methods G-Lab11- GS plus software	Chp15: Spatial Interpolation GIS-Lab15: Chp 15-Tasks 1-5
29	7/12 Tu	Kriging and other interpolation methods, Excel data for Surfer 8	Chp17: Path Analysis and Network Applications GIS-Lab16: Chp 17-Tasks 1-6
30	7/13 W	Kriging and other interpolation methods G-Lab12- Surfer 8 graphs	Chp18: GIS Model and Modeling GIS-Lab17: Chp 18-Tasks 1-6
31	7/14 Th	Kriging and other interpolation methods in GIS (see Chp 15)	GIS-Lab 18: download GIS data, Clip and Analyze DEM files, creating 3-D maps and TIN (Bb)
32	7/15 F	Graduation Seminar	Certificate of Participation

Evaluation Rubrics for Geostatistics and GIS Labs

Contents\Grade	Poor 2 pts	Fair 3 pts	Good 4 pts	Excellent 5 pts
Discussion Have the analysis answers been written in detail with accuracy and insight?	Answers to the questions show limited detail, accuracy and insight.	Answers to the questions show some detail, accuracy and insight.	Answers to the questions show considerable detail, accuracy and insight.	Answers to the questions show a high degree of detail, accuracy and insight.
Map Organization Has the map been designed in an organized manner?	The organization of the map is displayed with limited effectiveness.	The organization of the map shows some effectiveness.	Map is displayed and organized in an effective manner.	There is a high degree of effectiveness in the organization.
Map Technology Has the student exhibited an ability to use the software to achieve the desired results?	Exhibits no command of the software and is able to use it with limited effectiveness.	Exhibits satisfactory command of the software and is able to use it with some effectiveness.	Exhibits good command of the software and is able to use it effectively.	Exhibits a high degree of ability in the use of the software.
Map Application Does the layout contain all the necessary cartographic elements?	The layout is missing several elements. These may include a legend, compass, title etc.	The layout is missing one or two of the following: a legend, compass, title etc.	The layout is designed with effectiveness and includes necessary cartographic elements.	The layout contains all necessary elements and is designed with a high degree of effectiveness.

Evaluation Rubrics for Term Project Reports

Qualities & Criteria	Poor (0-59.9)	Moderate (60-79.9)	Good (80-100)
Format/Layout <i>(Weight 15%)</i>	Follows poorly the requirements related to format and layout.	Follows, for the most part, all the requirements related to format and layout. Some requirements are not followed.	Closely follows all the requirements related to format and layout.
Content/Information/Map <i>(Weight 50%)</i>	The essay is not objective and addresses poorly the issues referred in the proposed topic. The provided information is not necessary or not sufficient to discuss these issues. Maps were poorly organized and displayed.	The essay is objective and for the most part addresses with an in depth analysis most of the issues referred in the proposed topic. The provided information is, for the most part, necessary and sufficient to discuss these issues. Maps were well organized and displayed.	The essay is objective and addresses with an in depth analysis all the issues referred in the proposed topic. The provided information is necessary and sufficient to discuss these issues. Maps were very well organized and displayed.
Quality of Writing <i>(Weight 20%)</i>	The essay is not well written, and contains many spelling errors, and/or grammar errors and/or use of English errors. The essay is badly organized, lacks clarity and/or does not present ideas in a coherent way.	The essay is well written for the most part, without spelling, grammar or use of English errors. The essay is for the most part well organized, clear and presents ideas in a coherent way.	The essay is well written from start to finish, without spelling, grammar or use of English errors. The essay is well organized, clear and presents ideas in a coherent way.
References and use of references <i>(Weight 15%)</i>	Most of the references used are not important, and/or are not of good/scholarly quality. There is not a minimum of 5 scholarly resources, and/or they are not used effectively in the essay. References are not effectively used, and/or correctly cited and/or correctly listed in the reference list according to APA style.	Most of the references used are important, and are of good/scholarly quality. There is a minimum of 5 scholarly resources that are for the most part used effectively in the essay. Most of the references are effectively used, correctly cited and correctly listed in the reference list according to APA style.	All the references used are important, and are of good/scholarly quality. There is a minimum of 5 scholarly resources that are used effectively in the essay. All the references are effectively used, correctly cited and correctly listed in the reference list according to APA style.

Overriding criterion: Originality and authenticity. If the essay is identified as not being original, and/or not done by the student, the instructor has the right to grade the paper as an F.

REFERENCE MATERIALS:

- Gorr, W.L., and K. S. Kurland, *GIS Tutorial Workbook for ArcView 9*, ESRI Press, 2005. (ISBN 1-58948-127-5)
- Bernhardsen, T., 1999. *Geographic Information Systems: An Introduction*, 2nd Edition, John Wiley & Sons, New York.
- Clarke, K.C., 2003. *Getting Started with Geographic Information Systems*, 4th edition, Prentice Hall, New Jersey.
- DeMers, M.N., 2000. *Fundamentals of Geographic Information Systems*, 2nd Edition, John Wiley & Sons, New York.
- ESRI, 1990. *Understanding GIS: The ARC/INFO Way*, Environmental Systems Research Institute, Redlands.
- ESRI, 1996. *Using ArcView GIS*, Environmental Systems Research Institute, Redlands.
- ESRI, 1999. *Getting to know ArcView GIS*, Environmental Systems Research Institute, Redlands.
- Heywood, I., Cornelius, S. and Carver, S., 1998. *An Introduction to Geographical Information Systems*, Addison Wesley Longman, New York.
- Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W. (eds.), 1999. *Geographical Information Systems*, 2nd Edition, John Wiley & Sons, New York.
- Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W. (eds.), 2001. *Geographical Information Systems and Science*, 2nd Edition, John Wiley & Sons, Chichester.
- Star, J. and Estes, J., 1990. *Geographic Information Systems: An Introduction*, Prentice Hall, Englewood Cliffs.
- Tomlin, C.D., 1990. *Geographic Information Systems and Cartographic Modelling*, Prentice Hall, Englewood Cliffs.
- Zeiler, M., 1999. *Modeling Our World: The ESRI Guide to Geodatabase Design*. Environmental Systems Research Institute, Redlands.

Course Administration

Important Policy:

You will receive an “Incomplete” or “F” grade automatically if you miss more than 10 lab exercises, regardless of the work you have completed. Late penalty for exercises and assignments is 10% per day of delay. The project report must be presented with acceptable professional standards, i.e. clear logical layouts, neat and legible, no scribbling, no untidy work.

Students with Disabilities:

Upon identifying themselves to the instructor and the university, students with disabilities will receive reasonable accommodation for learning and evaluation. For more information, contact Services to Students with Disabilities in the University.

Cheating and Plagiarism:

"Cheating is the actual or attempted practice of fraudulent or deceptive acts for the purpose of improving one's grade or obtaining course credit; such acts also include assisting another student to do so. Typically, such acts occur in relation to examinations. However, it is the intent of this definition that the term 'cheating' not be limited to examination situations only, but that it include any and all actions by a student that are intended to gain an unearned academic advantage by fraudulent or deceptive means. Plagiarism is a specific form of cheating which consists of the misuse of the published and/or unpublished works of others by misrepresenting the material (i.e., their intellectual property) so used as one's own work." Penalties for cheating and plagiarism range from a 0 or F on a particular assignment, through an F for the course, to expulsion from the university. For more information on the University's policy regarding cheating and plagiarism, refer to the Class Schedule (Legal Notices on Cheating and Plagiarism) or the University Catalog (Policies and Regulations).

Disruptive Classroom Behavior:

"The classroom is a special environment in which students and faculty come together to promote learning and growth. It is essential to this learning environment that respect for the rights of others seeking to learn, respect for the professionalism of the instructor, and the general goals of academic freedom are maintained. ... Differences of viewpoint or concerns should be expressed in terms which are supportive of the learning process, creating an environment in which students and faculty may learn to reason with clarity and compassion, to share of themselves without losing their identities, and to develop and understanding of the community in which they live. Student conduct which disrupts the learning process shall not be tolerated and may lead to disciplinary action and/or removal from class."

Copyright policy:

Copyright laws and fair use policies protect the rights of those who have produced the material. The copy in this course has been provided for private study, scholarship, or research. Other uses may require permission from the copyright holder. The user of this work is responsible for adhering to copyright law of the U.S. (Title 17, U.S. Code).

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Subject-to-Change Notice:

This syllabus and schedule are subject to change depending on the course progress. The above schedule and procedures are subject to changes in the event of extenuating circumstances. If you are absent from class, it is your responsibility to check on announcements made while you were absent. Any substantive changes to this syllabus will be accompanied by the distribution of a revised syllabus.

Lab and Term Project Guideline

1. How to produce PDF files for your labs and combine them into one PDF for submission:

- In ArcView 9.x (ArcGIS): Access “layout view” by clicking the button at the lower left corner of normal view. Go to “file/export map”, then “save as” PDF file. Name the file as “GIS200-YourLastName-Firstname-Lab#”
- Combine your PDF files into one file for the same lab, by opening the first PDF file, then insert new pages using “Documents/Pages/Insert” functions, or follow the specific procedures in your version of Adobe PDF software.
- Please E-mail your PDF file as an attachment file (one PDF per lab) and **use the correct SUBJECT name of the e-mail**. Otherwise, your homework could be lost in the system.

2. How to prepare a project proposal?

In this term project proposal you will:

- Specify your project's objectives
- Briefly describe the information sources you expect to use
- List the expected results in terms of knowledge gained or analysis accomplished

It is understandable that in preparing a project proposal many things are not completely understood in the beginning and it is possible that major changes in the project may occur as you execute it. The main purpose of this outline is to give me an understanding of what you intend to do so that I can help you define a project that is feasible within the time frame and the information resources that are available. It is better to focus your ideas rather narrowly first and then broaden them out later. Many students start out attempting to do more than the time available during the semester will permit.

3. How to prepare the term project report?

A written report detailing each step should be submitted on or before the stated deadline. Ideas for term projects may come from past students, your professional work, GIS web sites, GIS magazines or research journals, etc. The written report should be double-spaced typed and limited to 10 pages or less, including necessary figures and tables. This report should have all components as outlined below. In the body of the report you are to present a thorough discussion of the data, the analysis, problems encountered and the solutions and new findings. As the reports will be graded somewhat subjectively and loosely based on their levels of usefulness, students are advised to seek for in priori approval from the instructor and must include the following sections:

- Title page (project title, abstract, student name, and email address)
- Introduction and Problem statements (up to 1 page)
- Data collection and assembly (up to 1 page)
- Analytical methodology and procedures (up to 2 pages)
- Results and discussion (up to 5 pages)
- Concluding remarks (up to 1 page)
- Cited references (list and cite at least 5 peer-reviewed references)

Reports will be graded based on

- Whether or not the problems can be solved without using GIS.
- Use of appropriate data sources
- Proper use of data analysis techniques (including 3-D analysis)
- Analytical methodology
- Grammar, spelling
- Report structure (abstract, table of content, bibliography, etc.)

Academic Honor Code signature page

Last Name _____ First Name _____ Date _____

Course Name: GIS200- Fundamentals of Geostataistics and GIS

Instructor: Dr Zhi Wang, Associate Professor of California State University, Fresno

HouJi Scholar and visiting professor of Northwest A & F University, China

"Members of the class adhere to principles of academic integrity and mutual respect while engaged in university work and related activities."

I will adhere to the above mentioned university Honor Code and the following principles:

- a) understand or seek clarification about expectations for academic integrity in this course (including **no cheating, plagiarism and inappropriate collaboration**);
- b) neither give nor receive unauthorized aid on examinations or other course work that is used by the instructor as the basis of grading; and
- c) take responsibility to monitor academic dishonesty in any form and to report it to the instructor or other appropriate official for action.

Signature