GEOGRAPHY & GEOLOGY — University of Wisconsin Stevens Point

Geography 472/672 GIS Environmental Modeling and Management Techniques Syllabus - SEM I 2013-14

Instructor: Eugene Martin. gmartin@uwsp.edu. Science B343.
Office hours: M 10 - 11; T 2 - 3; W 10 - 12; R 11 - 12; F 9 - 1 and by appointment

Course meeting times:

	Day	Hour	Location
Lecture	Tuesdays & Thursdays	9:00 - 9:50	Science B326
Lab	Mondays	8:00 - 9:50	Science B326

Description: Geog 472/672 is for students who wish to enhance their GIS problem-solving skills with challenges and analytic approaches commonly used in ecology, hydrology and atmospheric dispersion models. Analytical techniques and concepts introduced include spatial autocorrelation, point density/clustering, landscape change, local spatial statistics, geostatistics, runoff/erosion and air/water chemical dispersion. Of particular importance is the relationship between environmental model output and decision support for resource management. Lectures and reading assignments introduce the course concepts supported by practical experience in a series of lab exercises. Software featured in the course lectures and lab assignments include ArcMap 10x, PCRaster, R and NOAA GNOME.

Course learning outcomes

- Recognize and describe environmental models following Skidmoreï's typology.
- Describe the steps required to design and implement an environmental model.
- Apply Janertï¿½s graphical analysis concepts to visualize and explore the nature of spatial data and appropriateness for model use.
- Explain the importance of Toblerï¿½s law and autocorrelation for spatial statistics.
- Describe the primitives of geostatistical methods and correctly apply kriging to discern landscape characteristics.
- Explain the underlying analytical concepts and correctly apply density and clustering operations.
- Perform landscape suitability, change, and disturbance models
- Describe and apply the assumptions and requirements for modeling wildfires.
- Implement a hydrological model to quantify landscape form, drainage and flooding events.
- Integrate data to support a cost distance and habitat connectivity model.

Prerequisites: Geography 476 and 479 or instructor's consent

Expected capabilities: To succeed in this class you should already have facility with the ArcGIS software suite and be able to:

- Organize and manage files in the Windows environment (create folders, copy files, backup)
- Acquire and evaluate data suitability for use.
- Load tools, extension and layers to ArcGIS.
- Apply cartographic principles to explore, visualize and communicate with spatial data.
- Manipulate tables to edit data values, add fields, join tables, compute field statistic and perform attribute operations.
- Perform queries, overlays and map algebra to create new data layers.
- Convert feature themes to raster grid themes.
- Digitize or edit data for feature themes.
- Create publication quality cartographic products.

Instructor commitment: The instructor will a) present clear, engaging, challenging lecture/lab presentations; b) keep the course on schedule; c) challenge each student to question; d) conduct fair and equitable evaluation of student work; e) encourage student participation; f) be available and accessible by email and office hours or appointments; g) be responsive to student needs/requests.
The instructor will not a) provide *the correct* answer without students' critical engagement of the question; b) scale grades to an established curve; c) pretend to teach; d) let students pretend to learn.

Student commitment: Students are required to engage with the course through regular attendance, active participation, and successful completion of all assignments. Students are also expected to read all assigned materials and to ask informed questions regarding the subject matter. As per the Student Handbook, students should anticipate two hours of course work for each hour of lecture or lab. Geog472 consists of two lecture and two lab hours a week meaning students can expect an estimated eight hours of self study beyond scheduled lecture and lab times. Students having difficulty completing the course work should consult with the instructor before falling behind.

Student Rights and Responsibilities: Your rights and responsibilities within the UWSP campus community, including required behavior by students and faculty within the classroom environment are detailed in these documents:
http://www.uwsp.edu/admin/stuaffairs/rights/rightsCommBillRights.pdf
http://www.uwsp.edu/admin/stuaffairs/rights/rightsChap14.pdf.

Required text: The text for the course is Wainright, J. and Mulligan, M. (2004) *Environmental Modeling - Finding Simplicity in* Complexity.Wiley and Sons available for rental in the UWSP Bookstore. In addition there are assigned readings from a collection of book chapters and papers that best exemplify the core concepts of modeling and breadth of applications.

1. Albrecht (1996) Universal GIS Operations for Environmental Modeling. In: 3rd international conference on integrating GIS and environmental modeling CD-ROM
2. Barnsley, M.J. (2007). Visualizing environmental data. In: Environmental Modeling: A pracical introduction. Boca Raton: CRC. pp. 26-58.
3. Bivand, R., Pebesma, E. J., & GoÌ□mez-Rubio, V. (2013). *Applied spatial data analysis with R*. New York, NY: Springer.
4. Burrough, P.A. & McDonnell, R.A. (1998). Optimal interpolation using geostatics, Chapter 6. In: Principles of geographical information systems. Oxford: Oxford University Press. pp. 133-161.
5. Couclelis, H. Modeling frameworks, paradigms and approaches, Chapter 2. In: Clarke, K.C., Parks, B.O., Crane, M.P., & International Conference on Integrating Geographic Information Systems and Environmental Modeling. (2002). Geographic information systems and environmental modeling. Upper Saddle River, N.J.: Prentice Hall. pp. 36-50.
6. Corbett, White and Collins. Spatial decision support systems and environmental modeling: An application approach, Chapter 3. In: Clarke, K.C., Parks, B.O., Crane, M.P., & International Conference on Integrating Geographic Information Systems and Environmental Modeling. (2002). Geographic information systems and environmental modeling. Upper Saddle River, N.J.: Prentice Hall. pp. 51-66.
7. DeMers, M.N. (2005). Cartographic modeling, Chapter 13. In: Fundamentals of geographic information systems. New York: John Wiley & Sons. pp. 328-355.
8. Devore, J.L. (1982). Probability and statistics for engineering and the sciences. Monterey, Ca: Brooks/Cole Pub. Co. pp. 1-30.
9. Fortin, M.-J., & Dale, M. R. T. (2005). Spatial analysis: A guide for ecologists. Cambridge, N.Y: Cambridge University Press.
10. Fortner, B. (1995). The Data Handbook. New York: Springer Verlag. pp. 85-108.
11. Goovaerts, P. (1999). Geostatistics in soil science: state-of-the-art and perspectives. Geoderma, 89, 1, 1.
12. Hengl, T (2009). Geostatistical mapping. In: Hengl, T. (2009). A practical guide to geostatistical mapping. Amsterdam pp. 1-26.
13. Janert, P. K. (2010). Gnuplot in action: Understanding data with graphs. Greenwich, Conn: Manning.
14. Kemp (1996) Easing environmental models into GIS. In: 3rd international conference on integrating GIS and environmental modeling CD-ROM
15. Lam, L. (2010) An introduction to R. http://cran.r-project.org/doc/contrib/Lam-IntroductionToR_LHL.pdf
16. Maguire, D. J., Batty, M., & Goodchild, M. F. (2005). GIS, spatial analysis, and modeling. Redlands, Calif: ESRI Press.
17. Maindonald, J. H. (2008) Lattice and other graphics in R. Centre for Mathematics and Its Applications, Australian National University. http://maths-people.anu.edu.au/~johnm/r/rgraphics.pdf
18. Miller, H. J. (2004). Tobler's First Law and Spatial Analysis. Annals of the Association of American Geographers, 94(2), 2004, pp. 284?289
19. Moore, D.S. & McCabe, G.P. (1989). Looking at data relationships. In: Moore, D.S. and McCabe, G.P. Introduction to the practice of statistics: W.H. Freeman, pp. 149-252.

20. Oliver, M., Webster, R., & Gerrard, J. (1989). Geostatistics in Physical Geography. Part I: Theory. Transactions of the Institute of British Geographers, 14, 3, 259-269.
21. Perry et al (2002). Illustrations and guidelines for selecting statistical methods for quantifying spatial pattern in ecological data. Ecography, 25, 5, 578-600
22. Revelle, W. & The Personality Project (2011) Covariance, regression and correlation, Chapter 4. In: An introduction to psychometric theory with applications in R. Personality Motivation and Cognition Laboratory, Northwestern University. http://www.personality-project.org/r/book/chapter4.pdf
23. Rossiter, D. and Loza, A. (2012) Technical note: Analyzing land cover change with logictic regression in R. http://www.itc.nl/~rossiter/teach/R/R_lcc.pdf
24. Rossiter, D. (2012) Using the R environment for statistical computing. University of Twenty, Faculty of Geo-Information Science & Earth Observation (ITC). Enschede NL. http://www.itc.nl/~rossiter/teach/R/R_mhw.pdf
25. Sherman, M. (2010). Spatial statistics and spatio-temporal data: Covariance functions and directional properties. Oxford: Wiley-Blackwell.
26. Skidmore, A. and H. Prins (2002). Environmental modelling with GIS and remote sensing. London; New York, Taylor & Francis.
27. Slothower, Schwarz, and Johnston. (1996). Some Guidelines For Implementing Spatially Explicit, Individual-Based Ecological Models Within Location-Based Raster GIS. In: 3rd international conference on integrating GIS and environmental modeling CD-ROM
28. Stayaert, L.T. A Perspective on the state of environmental simulation modeling. In: Goodchild, M.F., Parks, B.O., & Stewart, L.T. (1993). Environmental modeling with GIS. New York: Oxford University Press. pp. 16-30.
29. Torfs, P. and Brauer, C. (2012) A (very) short introcution to R. Hydrology and Quantitative Water Management Group. Wageningen University, The Netherlands. http://cran.r-project.org/doc/contrib/Torfs+Brauer-Short-R-Intro.pdf
30. Venables, W. N., Smith, D. N. & R Development Core Team. (2006) An Introduction to R.
31. Westman, W.E. (1985). Ecology, impact assessment, and environmental planning. New York: Wiley. pp. 201-268.

Desire2Learn (D2L): The course D2L page is a resource for lecture, lab and assignment management. Students are expected to be familiar and proficient with all of D2L features and functions. Lecture/lab outlines are linked to online content, required readings and related assignments. Note: D2L course resources are not a substitute for attending lecture or lab. The lecture/lab content on D2L are not self-explanatory and do not support stand-alone self study. Drop boxes are used for submission of all course deliverables. .

Attendance: This course adheres to the UWSP attendance policy. Attendance is expected for all lectures and lab sessions. Regular attendance and participation in lecture and lab sessions are an integral and essential part of learning in this course. Attendence may be taken with a sign-in sheet at the beginning of each lecture/lab. After three absences a two point penalty will be applied to your final grade and again for each absence thereafter; see the grading scale below. Many themes presented in lecture and lab are not addressed in the required reading or on D2L content. University organization-sanctioned events, class field trips, death in the family, serious illness, accident, or similar are justifiable absences and will be considered for accommodation and a reasonable amount of additional help outside of normal lecture, lab and office hours. If you miss a class, even for a legitimate reason, you are still responsible for the material.

Lectures: Lectures introduce the core geographic information science concepts and practical applications that are further developed in the lab assignments. These build upon and extend material introduced in the required readings and concepts presented in prior lecture/lab meetings. They are the richest source of concise and accessible insight and knowledge needed to complete assignments and realize the course learning outcomes.

Software: ESRI's ArcGIS10x software with extensions is used to illustrate course concepts presented in lecture and use by students in the lab exercises. Statistics and spatial analysis will be handled predominantly using R statistical package from CRAN (http://www.r-project.org/) managed with the R-Studio integrated development environment (http://www.rstudio.com/ide/). Hydrological surface modeling will feature PCRaster (http://pcraster.geo.uu.nl/) and water surface trajectories in NOAA's GNOME Modeling tool. Lecture and lab presentations introduce software fundamentals leading up to each lab exercise. Students' software proficiency develops in the lab exercises through experiential learning and critical thinking. Work to accomplish the lab exercises and software self study will require additional time investment outside the hours of scheduled lecture and lab meetings.

SIAL Lab policies: Lab policies are posted on bulletin boards in the SIAL. See Diane Stelzer in the department office to receive keys for the lab. Please pay attention to the rules for the keys on the signed form especially the ones that will result is revocation of key privileges.

Printing costs: All deliverables in this class are handled through the D2L dropbox system. If you wish to print know that all student printers are now handed through UWSP-IT so you will be charged for 5 cents for each B&W page (single side) as well as 15 cents for each color copy (single side). You start out with $10 in a UWSP printing account for the semester (for all of your classes) and then are charged a fee at the end of the semester for any printing exceeding that initial balance. You can always check your student printing account on your myPoint portal page on the Finances tab. Most of your assignments that you hand-in will likely just be B&W copies and programming assignments will be graded through documentation (and final program) that you will deposit in your assigned class server directories.

Labs: Course lecture material is linked with practical application in seven lab exercises. Exercises include software operation instructions and questions that address the operations and course concepts. Exercises are worth between seven and ten points depending on difficulty; exercise questions are short answer worth 1-3 points each.
Answers to lab questions are graded according to the following criteria:

- Unacceptable - no credit: Answer is irrelevant, incorrect, or contains major flaws; clear misunderstanding of concepts or lack of effort.

- Satisfactory - partial credit: Answer addresses the subject but with minor flaws or is incomplete; does not exhibit mastery of concepts, techniques, problem solving, or critical thought.
- Good - full credit: Answer addresses the question directly and efficiently with appropriate and well reasoned application of concepts.

In most cases the exercises will require more time than available in a lab period (110 min) to complete and students should anticipate some additional time commitment. Exercises are due generally 7-10 days after they are assigned and submitted through D2L drop boxes. Exercises not submitted by the due date will not be graded. Exercises will be graded and reviewed in lecture the week after the due date. Students are expected to take ownership and responsibility for incorrect answers to lab exercises. Compare your answers to the answer sheets posted on D2L. Please consult by email or during office hours if you do not understand why your lab answers are incorrect

Exercise	Assigned	Due
Ex. 1 Introduction to R and data description/visualization	Sept 3	Sept. 16
Ex. 2 Point density and clustering	Sept. 16	Sept. 30
Ex. 3 Land cover change	Sept. 30	Oct. 14
Ex. 4 Geostatistics	Oct. 14	Oct. 28
Ex. 5 Atmospheric dispersion and water surface trajectories	Oct. 28	Nov. 11
Ex. 6 Local spatial statistics hotspots	Nov. 11	Nov. 25
Ex. 7 Local spatial statistics hotspots	Nov. 25	Dec. 16

Exams: The midterm and final exams are worth 20 points each. They consist of short answer questions worth two points each. Each lecture and lab assignment has clearlt stated learning outcomes that are directly related to the exams and project assignment. Students will receive a list of learning outcomes addressed in each exam a week before the exam date. Time management during the exams is important; delay will make it difficult to answer all questions completely. Students who do not take the midterm and final exams are not eligible for a passing grade.
Exam questions are graded to the following criteria:

- Unacceptable - no credit: Inappropriate, incorrect, incomplete; more wrong than right.
- Problematic - partial credit: Vague, insufficient detail, major inaccuracies, relevancy implied; more right than wrong

- Good - full credit: Clearly relevant, appropriate detail, no inaccuracies, thorough and complete; nothing wrong.

Evaluation: Final grades are based on points earned for successful completion of the lab exercises, and exams.

60%	Laboratory exercises - Seven exercises each worth 7 or 9 points.
20%	Midterm - 20 points
20%	Final - 20 points.

Grades will not be scaled except in extenuating circumstances. All students are eligible to earn an A; grades are not competitive.

Grading scale:

Points	Grade
93-100	A 4.0
90-93	A- 3.7
87-89	B+ 3.3
83-86	B 3.0
80-82	B- 2.7
77-79	C+ 2.3
73-76	C 2.0
70-72	C- 1.7
66-69	D+ 1.3
60-65	D 1.0
0 - 59	F

Graduate 672 requirements: Expectations and requirements for graduate students are different The due dates, weights and grading scale for 672 are the same as 472 but the assignments and learning expectations are commensurate with graduate level studies. Lab assignments, midterm exam and final exam have additional or more challenging questions. Final projects are individual and should address element related to thesis or dissertation research. This is an opportunity to explore inherent spatial relationships and their implications for research. Projects can be a vehicle to develop and evaluate analysis strategies in preparation for more rigorous use. Project written reports should include sufficient description and detail to situate work in the discipline of choice and present conclusions that tie the project back to a larger research agenda.

Plagiarism: Plagiarism is defined in Chapter 14 of the UWSP Rights and Responsibilities section14.03. You plagiarize if you use someone else's ideas, even if you paraphrase them, and do not cite them. All assignments submitted to D2L drop boxes are evaluated with Turnitin.com for plagerism. Answers to exam questions or lab assignments that are too similar to be clearly original work will not receive a grade. See http://www.plagiarism.org/plag_article_what_is_plagiarism.html for more explaination and steps you can take to avoid plagiarism.

Disabilities: Students with disabilities or requirements of any nature should meet with the instructor during the first week of classes to address satisfactory accommodation.

"Simply put, the greater the student's involvement or engagement in the academic experience of college, the greater his or her level of knowledge acquisition and general cognitive development" (*How College Affects Students*, Pascarella and Terenzini, 1991)

Getting help and how to succeed:

- *Attend lecture & lab meetings:* Regular lecture and lab section attendance is the single most effective investment toward success in Geog472. Lecture material builds upon and goes beyond the required readings as the foundation for the lab exercises. You should anticipate difficulty with timely completion of the lab exercises if you miss lecture/lab and do not recover.
- *Follow the learning outcomes:* The learning outcomes listed on the lecture and lab pages are the take home concepts of the course. They are what you need to know to succeed with GIS and are the basis for the lab exercises and exams.
- *Notetaking:* Taking notes during class meetings is a proven means of knowledge retention. Notes also help identify omissions and areas of difficulty during study and office hour consultations. Students are encouraged to share and compare notes with other students to improve understanding and learning.
- *Participate:* Participation is not part of the course grade even though it is one of the best ways to learn and reduce the time required to master course concepts. Ask questions in class and on the D2L discussion forums to recieve answers that address your learning needs.
- *Meet with the instructor:* The instructor is available to address your individual learning needs during office hours and by appointment. Scheduled office hours are open for drop-in consultation although prior scheduling is appreciated. Office hour topics include but are not limited to: a) further explaination of lecture material and lab exercises; b) software tech support; c) project design and troubleshooting; d) exam preparation; e) grading and evaluation discrepancies. Office hours and appointments are also open for study groups or project teams to focus on selected questions.
- *Submit assignments on time:* Prompt submission of required assignments by their due date to insure that you get points for the assignments.
- *Read the required readings:* Do this before the lecture/lab when they are discussed. Familiarity with the required reading is expected and serves as the foundation for lecture presentations. Required readings are part of the lecture quizzes.

- *Exam preparation:* Pay attention to the learning outcomes associated with the lectures and labs because these are basis for the quizzes, midterm and final. Make sure you know what is expected and practice answering the sample exam questions provided.
- *Do your own work:* Any lab exercise deliverable or exam question with answers that are too similar to others&' work to be unmistakably original will not receive a grade. Please take care to insure that your work is yours alone and not accessible to other students. All assignment deliverables are checked with Turnitin.com. See the section on plagiarism below.