NR512: SPATIAL STATISTICAL MODELING
OF NATURAL RESOURCES
Department of Forest and Rangeland Stewardship
Warner College of Natural Resources

COURSE SYLLABUS

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Name: Robin M. Reich</th>
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<tr>
<td>Office:</td>
<td>130 Forestry</td>
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<tr>
<td>E-Mail:</td>
<td><a href="mailto:Robin.reich@colostate.edu">Robin.reich@colostate.edu</a></td>
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<tr>
<td>Office Hours:</td>
<td>MWF 8 - 10 and 11 - 12</td>
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<td>TR 8 - 9</td>
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<td>Or by appointment</td>
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<tr>
<th>Term:</th>
<th>Fall 2014</th>
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<td>Class Meeting Days:</td>
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<tr>
<td>Class Meeting Hours:</td>
<td>9-10:15</td>
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<td>Class Location:</td>
<td>127 Forestry</td>
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<td>Course Credits:</td>
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Course Overview
Provide students with the knowledge and skills to integrate GIS, remote sensing data and spatial statistics to develop models describing the spatial variability in natural and environmental resources.

Course Goals and Objectives
The course will be project oriented. Students will apply the knowledge learned in GIS/remote sensing and statistics in solving real world problems. Examples are taken from current and on-going research projects and include: modeling forest stand structure; forest fuels; soil texture; extent and severity of insect infestations; spatial relationship among violent crime, poverty and teenage idleness in Denver, Colorado.

Students will develop skills to:
1. Select and apply appropriate visualization and numerical techniques to explore the structure of a spatial data set;
2. Select and apply appropriate procedures to model the structure of a spatial data set;
3. Select and apply appropriate procedures to predict data values at unvisited locations using parametric and non-parametric models;
4. Design sampling strategies to reveal or account for spatial structure.
5. Use the R environment for statistical computing at an intermediate level and be able to improve their skills by self-study and experimentation.

Students are encouraged to bring spatial analysis questions from their own research. As time permits, we will discuss techniques appropriate for student research projects.
Course Prerequisites
It is recommended that students have some background in statistics, GIS and remote sensing. Suggested background courses include but not limited to: ST301 (Introduction to Statistics), NR322 (Introduction to GIS) and NR323 (Remote Sensing of Natural Resources).

Required Texts and Materials
- Class manual provided by the instructor
- R – software environment for statistical computing and graphics
- ArcGIS 10.0 or higher

Important Dates to Remember
Thanksgiving Break: Sat, Nov 22, 2014 – Sun, Nov. 30, 2014
Mid-Term Exam Tue, Oct 28, 2014
Final Examination: Wed, Dec 15, 2014, 11:50 p.m. - 1:50 p.m.

Exam dates are tentative and can be changed based on the pace in which the course material is presented in class.

Lecture Topics
Week 1 Introduction to spatial statistics, sampling strategies (model-based vs. model-assisted sampling designs, plot size, sampling designs, etc.), spatial association
Week 2-3 Spatial autocorrelation and cross-correlation, scales of pattern
Week 4-5 Regression models, spatial autoregressive and spatial lag models, spatial ANOVA, spatial t-tests
Week 6 Exploratory spatial data analysis, spatial estimation
Week 7-8 Spatial modeling, trend surface models, generalized least squares
Week 9-11 Ordinary kriging, universal kriging, regression kriging
Week 12 Categorical kriging, disjunctive kriging
Week 13 Classification and regression trees (CART)
Week 15 Cross-validation
Week 16 Case studies
Week 17 Finals week

Student Presentations:
Students will present two -10 to 15 minute critiques of journal articles related to spatial statistical modeling and lead a discussion of the articles in class. Presentations will be scheduled throughout the semester to correspond to the lectures, if possible. Prior to the presentations, students will be responsible for distributing copies of the articles to the class so everyone will have had an opportunity to read the articles prior to the presentations.

Basis for Final Grade
The course grade will be based on the following distribution:

<table>
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<tr>
<th>Assessment</th>
<th>Percent of Final Grade</th>
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<tbody>
<tr>
<td>Homework</td>
<td>50%</td>
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<tr>
<td>Exams (Mid-Term and Final)</td>
<td>35%</td>
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<tr>
<td>Presentations/Participation</td>
<td>15%</td>
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<td>100%</td>
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Letter grades will be assigned based on the following percentage points; A: 90%-100%, B: < 80%.
**Course Policies**

**Homework Policy:**
Students are expected to work independently and to complete the assignments on time. Homework turned in late will be assessed a penalty: 5% if it is one day late, plus an additional 10% per day if it is late by more than one day. Homework will not be accepted if overdue by more than seven days. Copying of homework will result in loss of credit. Students are required to show all their work when doing the homework. Failure to do so will result in the loss of points (max 60%). All homework assignments should be legible. Homework assignments that are difficult to read, or follow will not be graded or, will have points deducted (max 20%).

**Grades of "Incomplete":**
Per university policy, an instructor may assign temporary grade of Incomplete to a student who demonstrates that he or she could not complete the requirements of the course due to circumstances beyond the student's control and not reasonably foreseeable. A student must be passing a course at the time that an Incomplete is requested unless the instructor determines that there are extenuating circumstances to assign an Incomplete to a student who is not passing the course. When an instructor assigns an Incomplete, he or she shall specify in writing using the Department Incomplete Grade Form the requirements the student shall fulfill to complete the course as well as the reasons for granting an Incomplete when the student is not passing the course. The instructor shall retain a copy of this statement in his or her grade records and provide copies to the student and the department head or his or her designee. (Section I.6 of the Academic Faculty and Administrative Professional Manual)

**Disability Access:**
Colorado State University is committed to providing reasonable accommodations for all persons with disabilities. Students with disabilities who need accommodations must first contact Resources for Disabled Students before requesting accommodations from the professor. Resources for Disabled Students (RDS; http://rds.colostate.edu/home) is located in room 100 of the General Services Building. Their phone is (970) 491-6385 (V/TDD). Students who need accommodations in this course must contact the professor at the beginning of the semester to discuss needed accommodations.

**Religious Accommodation:**
Participation in official University activities, e.g., an out-of-town athletic event, or special religious observances may provide a legitimate reason for an excused absence. The student is responsible for discussing this with the instructor at the beginning of the semester.

**Final Exam Policy:**
Final examination week is part of the regular semester. Student attendance shall be consistent with University policy.

If a student has three or more final examinations (not classes) scheduled for the same day or if conflicts of examination times occur, the student may negotiate a time change with the instructors involved. If the parties involved cannot find a mutually agreeable time, the Registrar's Office indicates which courses must be changed. **Note:** The Registrar’s Office must be notified at least one week prior to Final Examination Week to allow instructors time to make appropriate accommodations. It is the student’s responsibility to initiate negotiations.

Any student who has a conflict with the examination schedule must inform the instructor as soon as possible before the examination. If an agreement cannot be reached between the instructor and student as to the appropriateness of a make-up examination the student should appeal to the department head.

http://www.registrar.colostate.edu/final-exams
Professionalism Policy:
Per university policy and classroom etiquette; mobile phones, iPods, etc. must be silenced during all classroom and lab lectures. Those not heeding this rule will be asked to leave the classroom/lab immediately so as to not disrupt the learning environment. Please arrive on time for all class meetings. Students who habitually disturb the class by talking, arriving late, etc., and have been warned may suffer a reduction in their final class grade. When emailing the instructor or TA, please include your full name, CSU ID, and the course number in your email.

Academic Integrity:
The Department of Forest and Rangeland Stewardship takes academic integrity seriously. At minimum, academic integrity means that no one will use another's work as their own. The CSU writing center defines plagiarism this way:

Plagiarism is the unauthorized or unacknowledged use of another person's academic or scholarly work. Done on purpose, it is cheating. Done accidentally, it is no less serious. Regardless of how it occurs, plagiarism is a theft of intellectual property and a violation of an ironclad rule demanding "credit be given where credit is due."

If you plagiarize in your work you could lose credit for the plagiarized work, fail the assignment, or fail the course. Each instance of plagiarism, classroom cheating, and other types of academic dishonesty will be addressed according to the principles published in the CSU General Catalog (see page seven, column two: http://www.catalog.colostate.edu/FrontPDF/1.6POLICIES1112f.pdf).

Of course, academic integrity means more than just avoiding plagiarism. It also involves doing your own reading and studying. It includes regular class attendance, careful consideration of all class materials, and engagement with the class and your fellow students. Academic integrity lies at the core of our common goal: to create an intellectually honest and rigorous community. Because academic integrity, and the personal and social integrity of which academic integrity is an integral part, is so central to our mission as students, teachers, scholars, and citizens, we will ask to you sign the CSU Honor Pledge as part of completing all of our major assignments. While you will not be required to sign the honor pledge, we will ask each of you to write and sign the following statement on your papers and exams:

"I have not given, received, or used any unauthorized assistance."