Course Description
This course is about quantitative analysis of spatial data. It is intended to provide a broad survey of various spatial statistic methods useful in environmental and social sciences. This course covers four broad topical areas: (1) point pattern analysis; (2) area data analysis; (3) continuous data analysis; (4) spatial sampling; and (5) multivariate spatial and temporal analysis. The course is a mix of theories, methods, and applications geared towards helping students: (1) develop an understanding of the important theoretical concepts in spatial statistical analysis; and (2) gain practical experience in applying spatial statistics to a variety of social and environmental problems using advanced statistical software.

Learning Outcomes
Upon completion of this course, students should be able to
- Understand concepts of homogenous (complete spatial randomness) and heterogeneous spatial process
- Understand concept of spatial autocorrelation
- Identify and interpret global and local spatial patterns of point and polygon data
- Understand the principals and practical applications of ordinary least square regression and spatial regression
- Understand and distinguish deterministic and stochastic spatial interpolation
- Understand the principals and practical applications of experimental semivariograms, semivariogram models, kriging, and cross validation
- Understand the principals and practical applications of spatial sampling
- Understand the principals and practical applications of spatiotemporal pattern analysis
- Apply proper spatial analysis methods for their own research using various statistical software and interpret spatial analysis results

Prerequisites
Students are expected to have backgrounds in elementary statistics and introductory GIS.

Course Requirements and Grading
It is strongly encouraged to attend each lecture and actively participate in online discussion board as well as in class. Students are required to post a reply on the issue posted by the instructor. Lab assignments will be given on a weekly basis to help students gain practical experience to answer
specific problems. Students need to complete final projects with spatial data in their area of interest using various methods covered in this course. Final grades will be determined by the following items:

- Weekly quizzes & discussions 5%
- Lab assignments 65%
- Final project 30%

**Required Textbooks**

This course will include many contents from several books and papers. There are four textbooks mainly referenced in the course. If you don’t have any spatial statistic book, I recommend you get at least one book, Statistical Methods for Geography written by P. Rogerson which covers the subjects of Week1-6. Electronic versions of other books are listed below or will be posted on ELMS.


**Recommended Textbooks & References**


**Make-up Policy**

Assignments must be turned in by 11:59PM at which they are due. Late assignments will result in penalties unless prior arrangements are made with the instructor. If you have a documented disability and wish to discuss academic accommodations, please contact the instructor immediately. Students should not expect ‘Incomplete’ grade as they will be only given under extra-ordinary circumstances.

**Academic Integrity**

The University of Maryland, College Park, has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student, you are responsible for upholding these standards for this course. It is very important for you to be aware of the
consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.shc.umd.edu.

Within our class, students may work together to review class notes and home assignments. However, assignments must be done individually. Each student must turn in his or her own work, from his or her own computer. Any discussion or problem solution must be his or her alone, without assistance from any other person.

**Disabilities and Religion**
Any student with a disability is encouraged to meet with the instructor privately during the first week of class to discuss accommodations. I will make every effort to accommodate students who are registered with the Disability Support Services (DSS) Office and provide a DSS accommodation form. Please refer to the Online Undergraduate Catalog Policy on Religious Observance.

**Sustainability**
In an effort to promote greater understanding of sustainability among students, faculty, and staff at the University of Maryland, this course has been adapted to include discussion about larger sustainability issues, such as global climate change, food security, and systems modeling. Visit the University of Maryland's office of sustainability at: http://www.sustainability.umd.edu/.

**Online Learning**
This is an online course with occasional in-person experiences. We will meet online at the announced time for a live audio/video lecture. The lecture will be archived for anyone who absolutely must miss the class, but I encourage you to login at the appointed time so that you can ask questions.

Our class will meet within Blackboard, the university’s online learning system. Go to http://elms.umd.edu to access the course. After you login, our course will be listed in the right column under My Courses. Click on the course link to access the course.

Short videos that illustrate how to use the online learning system are available on the course page. Click the Tutorials button on the left sidebar to access the tutorials.

**Software Requirements for this course**
- ArcGIS 10.3 are required to install on your computer. Spatial Statistics and Geostatistical Analyst in ArcMap will be used in the labs. If you didn’t get an ArcGIS 10.3 license code from the department, contact with Kristin Bergery (kbergery@umd.edu).
- SPSS is software package used for statistical analysis. It is not a spatial statistic software package but can be used to apply classical statistics which is the basis of spatial statistics. Student can download free 1 year licensed SPSS software from http://terpware.umd.edu/Windows/title/1880
- This course introduces and use Free Spatial Statistical Software such as CrimeSat, GeoSurveillance, GeoDa, etc. The installation details will be provided during the class.

All students must have a UMD TerpConnect (used to be Glue) account to obtain permissions to access the software in the computer labs on campus (LeFrak 1136 1137) and on VMWare virtual
computers. You can access virtual computers remotely through VMWare Client View. VMWare View Client tutorial (MPS_ViewTutorial-VMWare.pdf) will be posted on ELMS.

**Hardware Requirement for this course**
You may use either a PC or a Macintosh computer to access ELMS. Whichever you choose, it must be equipped with the following hardware:
- Headset (including headphones and microphone)
- Webcam (optional)
You will also need the following plug-ins (be sure you have the latest versions):
- Adobe Flash Player

**Support for Online Learning**
This method of taking classes is undoubtedly new to some of you, so we have a few tools to make life easier for you.

**Email**
Both TA and instructor will always be available by email. Use the email link in the sidebar to send us emails at any time. We will try to answer within 24 hours and probably much sooner.

**Online office hours**
We will have office hours in a Live Classroom each week. The times will be posted in the Announcements. Use the link in the sidebar to access office hours.

**On campus office hours**
We will post times when we will be available on campus for face-to-face office hours. The TAs will have lab office hours on periodic Saturday mornings.

**Online Discussion & Chat rooms**
We have created places for you to visit with your classmates. Share everything from discussions about the course material to what you did last weekend. I will look in from time to time but I probably won’t respond to anything posted.

**Course Schedule**
This is a tentative schedule and may be adjusted to suit our class. Changes will be announced and posted on Blackboard.

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<thead>
<tr>
<th>Dates</th>
<th>Topics</th>
<th>Reading</th>
<th>Assignment</th>
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<tbody>
<tr>
<td>Aug 31</td>
<td>Overview of spatial statistics</td>
<td>RP Ch 1, 2, 3, 4</td>
<td>Lab1 Out</td>
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<td></td>
<td>Review of elementary statistics</td>
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<td>• Probability concepts</td>
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<td>• Probability distributions</td>
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<td>• Sampling theory</td>
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<td>Sep 1</td>
<td>Review of elementary statistics</td>
<td>RP Ch 5</td>
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<td>• Hypothesis test</td>
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<td>Sep 7</td>
<td>Spatial process: Complete Spatial Randomness</td>
<td>RP 2.6</td>
<td>Lab 1 Due</td>
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<td>Issues in analyzing spatial data</td>
<td>RP Ch 8.2</td>
<td>Lab2 Out</td>
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<td>Date</td>
<td>Topic</td>
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<tr>
<td>Sep 8</td>
<td>Point pattern analysis</td>
<td>OU Ch 2.2, 2.3, 4, 5, 6</td>
<td>Lab 1 Due, Lab 2 Due, Lab 3 Out</td>
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<td>Sep 14</td>
<td>Cluster detection analysis</td>
<td>RY Ch 5, OU Ch 6.7</td>
<td>Lab 2 Due, Lab 3 Out</td>
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<td>Sep 15</td>
<td>CrimeSat</td>
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<td>Lab 3 Out</td>
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<td>Sep 21</td>
<td>Spatial autocorrelation</td>
<td>RP Ch 10.3, 10.4, OU Ch 7</td>
<td>Lab 3 Due, Lab 4 Out</td>
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<td>Sep 22</td>
<td>Useful GIS Data Resources</td>
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<td>Final Project Topic Discussion Out</td>
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<td>Sep 28</td>
<td>OLS Regression, Logistic Regression, Spatial Regression</td>
<td>RP Ch 8 9 11.3</td>
<td>Lab 4 Due, Lab 5 Out, Final Project Topic Discussion Due:</td>
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<td>Sep 29</td>
<td>Geographic Weighted Regression (GWR)</td>
<td>RP Ch 11.4</td>
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<td>Oct 5</td>
<td>Factor Analysis, Principal Component Analysis, Spatial interpolation • Deterministic approach • Stochastic (Geostatistical) approach</td>
<td>RP 12 OU Ch 8 IR Ch 7</td>
<td>Lab 5 Due, Lab 6 Out, Proposal Out</td>
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<td>Oct 6</td>
<td>Stochastic spatial interpolation</td>
<td>OU Ch 9 IR Ch 7</td>
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<td>Oct 12</td>
<td>Stochastic spatial interpolation • Modeling varigram • Kriging</td>
<td>IR Ch 7 12 15</td>
<td>Lab 6 Due, Lab 7 Out</td>
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<td>Oct 13</td>
<td>Spatial interpolation • Kriging • Effects of variogram parameters on kriging</td>
<td>IR Ch 15 16</td>
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<td>Oct 19</td>
<td>Spatial interpolation • Empirical Bayesian Kriging • Areal Interpolation</td>
<td>IR Ch 16</td>
<td>Lab 7 Due</td>
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<td>Oct 20</td>
<td>Spatial Sampling</td>
<td>SO</td>
<td>Proposal Due</td>
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<td>Oct 26</td>
<td>Spatio-temporal data analysis</td>
<td>RY 6 7</td>
<td>Lab 8 (Optional for bonus points) Out</td>
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<td>Oct 27</td>
<td>Spatio-temporal data analysis</td>
<td>RY 7 8 9</td>
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<tr>
<td>Nov 2</td>
<td>Review of applications of spatial statistics</td>
<td>FB Ch 8</td>
<td>Lab 8 &amp; Project Due: Nov 6</td>
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