GIST 4302/5302: Spatial Analysis and Modeling  
SPRING 2016

**Lectures:** Tuesdays & Thursdays **12:30pm-1:20pm**, Science 234
**Labs:** GIST 4302: Monday **1:00-2:50pm** or Tuesday **2:00-3:50pm**  
GIST 5302: Wednesday **2:00-3:50pm**

**Course Homepage:** [http://www.gis.ttu.edu/gist4302](http://www.gis.ttu.edu/gist4302)

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**Office Hours:** M,W 10:00-11:00am  
**Email:** ashley.morris@ttu.edu

*This syllabus is tentative and subject to change*

1 Course description

With the continuing advances of technological development, spatial data have been easily and increasingly available in the past decades and becoming important information sources in daily decision makings. This class is intended for students (undergraduate and graduate students) from relevant disciplines (e.g., geography, geology, environmental science and social sciences) who are interested in analysis of spatial data. Students will be encouraged to engage this course with their thesis/dissertation topics and research interests.

This course will introduce fundamental concepts and commonly used methods in quantitative analysis of spatial data. Specifically, this course includes:

- Representation of spatial data (fundamentals in spatial databases)
- Concepts in spatial analysis and spatial statistics
- Spatial analysis methods for various types of spatial data (spatial points, networks, and areal/lattice data), including overlay/suitability analysis, spatial statistical methods such as exploratory spatial data analysis (e.g., Moran’s I), spatial interpolation (e.g. kriging) and spatial regression.

A lab/discussion session (approximately 2 hours) follows the lecture for students to gain hands-on experiences on real-world datasets by using multiple software tools. The software packages utilized in lab sessions include ArcGIS, Open GeoDa, R or Matlab. Students (graduate students in particular) with expertise or interest in the statistical package R or Matlab are encouraged to use them but it is not required.
2 Prerequisites

Prerequisites of this course includes an understanding of basic algebra, general statistics (e.g., knowledge of statistical significance) and matrix manipulations, and working knowledge of at least one GIS software packages, e.g. ArcGIS, which could be fulfilled with GIST 3300/5300. However, students from different disciplines are welcome, please contact the instructor should there any question about the prerequisites.

3 Learning outcomes

After completing this course, the undergraduate students of this class are expected to learn how to:

• formulate real-world problems in the context of geographic information systems and spatial analysis
• apply appropriate spatial analytical methods to solve the problems
• utilize mainstream software tools (commercial or open-source) to solve spatial problems
• communicate results of spatial analysis in the forms of writing and presentation

In addition to the above, the graduate students of this class are expected to learn

• the concept of spatial uncertainty
• commonly used spatial statistical methods work and connect them to the thesis and dissertation work
• evaluation and assessment of the results of alternative methods

4 Readings

The main course text is:

• O’Sullivan, David and David J. Unwin (2010), Geographic Information Analysis, 2nd Edition, John Wily & Sons. The first edition of this book works in the most cases as well.

The following books will be helpful for some topics of this class. Additional readings and handouts ill be suggested as the class progresses.

• Fotheringham, A.S., Brundson, C., and M. Charlton (2003), Geographically Weighted Regression, John Wiley & Sons.

For the lab assignments, you have different options of software tools to choose from. If using ArcGIS, you might find the following book helpful:


if using R:


if using Matlab:


5 Assessment

There are two written exams in this course (a midterm and a final), lab exercises, and a final project that includes a project proposal and final report. Graduate students will have extra questions for the lab and the exams, and higher standard for the final project outcomes. The exams are used to assess your understanding of the basic concepts discussed in the lecture, and the format of the exams will consist of a combination of multiple choice, short answer and short essay questions.

The purpose of the final project is to provide experiences for students to apply the methods and tools learned from this class to real-world spatial problems. Topics of the final project could be related to the spatial aspect of a thesis or another course work. The proposal associated with the final project should include a clear description of the proposed problems with appropriate background literatures justifying the motivation, description of the collected data sources, and methodology adopted
to address the problem. When the project proposal is due (Nov.3rd), students are expected to have collected the necessary data at hand. The final project will require a presentation of about 6-10 mins (PechaKucha style: http://en.wikipedia.org/wiki/Pecha_Kucha), and a final project report. Students are encouraged to start thinking of project ideas early in the semester, and communicate them with the instructor and the TA for feedbacks and comments.

6 Grading

Each exam, lab exercise and final project is worth 100 points, and the final points will be a combination of these three elements according to the following weights:

- two written exams: 30% (each 15%)
- six (out of nine) lab exercises: 40% (each ∼6.6%)
- final project proposal (5%), presentation (10%) and paper (15%) : 30%

To ensure a specific grade in this course you must meet the following minimum requirements: A - 90%, B - 80%, C - 70%, D - 60%.

7 University policy

- Students with disabilities (OP 34.22): http://www.depts.ttu.edu/opmanual/OP34.22.pdf
- Students absence for observance of a religious holy day (OP 34.19): http://www.depts.ttu.edu/opmanual/OP34.19.pdf
### Course outline

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<tr>
<th>Week#</th>
<th>Lecture Dates</th>
<th>Lecture Topics</th>
<th>Readings</th>
<th>Lab/Discussion Topics</th>
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<tbody>
<tr>
<td>1</td>
<td>Jan. 21th</td>
<td>Overview of the course</td>
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<td>No lab</td>
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<tr>
<td>2</td>
<td>Jan. 26</td>
<td>Introduction to spatial data analysis</td>
<td>O'S&amp;U ch.1</td>
<td>Review of map projections and overview of ArcMap</td>
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<td></td>
<td>Jan. 28th</td>
<td>Spatial data representation and spatial operations</td>
<td>O'S&amp;U ch.1, 10</td>
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<td>3</td>
<td>Feb. 2 &amp; 4</td>
<td>Spatial data representation and spatial operations</td>
<td>O'S&amp;U ch.1, 10</td>
<td>Spatial query: Finding what’s inside</td>
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<td>4</td>
<td>Feb. 9</td>
<td>Probability and statistics review</td>
<td>O'S&amp;U appendix A-B</td>
<td>Spatial query: Finding what’s nearby</td>
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<td></td>
<td>Feb. 11th</td>
<td>Pitfalls and potentials of spatial data</td>
<td>O'S&amp;U ch.2</td>
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<td>5</td>
<td>Feb. 16 &amp; 18</td>
<td>Spatial point pattern analysis</td>
<td>O'S&amp;U ch.4-5</td>
<td>Build a model builder</td>
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<td>6</td>
<td>Feb. 23 &amp; 25</td>
<td>Spatial point pattern analysis</td>
<td>O'S&amp;U ch.4-5</td>
<td>Point pattern analysis</td>
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<td>7</td>
<td>Mar. 1 &amp; 3</td>
<td>Spatial statistics of area objects, exploratory spatial analysis</td>
<td>O'S&amp;U ch.7</td>
<td>Mapping with GeoDa</td>
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<td>8</td>
<td>Mar. 8</td>
<td>Review and student project discussion</td>
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<td>Student project discussion</td>
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<td>Mar. 10</td>
<td>Exam I</td>
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<td>Mar. 15 &amp; 17</td>
<td>Sprint break</td>
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<td>10</td>
<td>Mar. 12 &amp; 24</td>
<td>Simple linear regressions and spatial regression</td>
<td>F&amp;B&amp;C ch.2-5</td>
<td>Descriptive spatial statistics using GeoDa</td>
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<td>11</td>
<td>Mar. 29 &amp; 31</td>
<td>Simple linear regressions and spatial regression</td>
<td>F&amp;B&amp;C ch.2-5</td>
<td>Spatial Regression using GeoDa</td>
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<td>12</td>
<td>Apr. 5 &amp; 7</td>
<td>Introduction to geostatistics (kriging)</td>
<td>O’S&amp;U ch.8-9</td>
<td>Spatial interpolation using ArcGIS</td>
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<td>13</td>
<td>Apr. 12 &amp; 14</td>
<td>Introduction to geostatistics (kriging)</td>
<td>O’S&amp;U ch.8-9</td>
<td>Proposal due (data should be ready) &amp; Student project</td>
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<td>14</td>
<td>Apr. 19 &amp; 21</td>
<td>Spatial uncertainty</td>
<td>O’S&amp;U ch.8-9</td>
<td>Student project</td>
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<td>15</td>
<td>Apr. 26 &amp; 28</td>
<td>Frontiers of spatial analysis</td>
<td>O’S&amp;U (1st Edition) ch. 13</td>
<td>Student project</td>
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<td>16</td>
<td>May. 3 &amp; May. 5</td>
<td>Project presentation</td>
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<td>Project presentation</td>
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<td>May. 10</td>
<td>Review</td>
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<td>18</td>
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