School of Geography and Earth Sciences
McMaster University

Advanced Topics in Spatial Statistics
GEOG 4GA3

COURSE OUTLINE

Instructor

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Instructional Assistant

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Course description

Spatial statistics is an area of spatial analysis that has become essential for the study of social and natural processes. It encompasses an array of methods and techniques for visualization, exploration and modeling of spatial data. As such, a sound understanding and the ability to use effectively spatial statistics constitutes an integral element of training in spatial analysis and Geographic Information Science. Most problems in spatial statistics fall into one of three major areas of analysis, depending upon the type of spatial data available or the spatial processes under study. These are:

- Point pattern analysis
- The analysis of spatially continuous data
- The analysis of area data.

Earth Sciences/Environmental Science/Geography 4GA3 (Applied Spatial Statistics) is an advanced follow up to Geography 3MB3 (Statistical Analysis). Whereas the focus in the introductory course was on descriptive statistics, exploratory techniques, analysis of categorical data, and fundamentals of regression, in this course the emphasis is on the unique challenges presented, and the opportunities afforded by spatial data, for exploration, visualization, and modeling of spatial processes.

Course objectives

At the end of the course, you should be able to:

1. Demonstrate sound geographical problem-solving skills.
2. Correctly identify different types of spatial data, and to select appropriate analytical methods and techniques.
3. Describe and discuss the main elements of the above methods and techniques.
4. Proficiently use ArcGIS Pro, R, and GeoDa computer packages to analyze spatial data.
5. Interpret the result of your analysis, and to support your interpretation with articulate descriptions of a spatial process.

**Organization of the course**

**Lectures:** Monday & Wednesday 13:30 – 14:20, ABB/166
**Labs:**
L01 Wednesday 16:30 – 18:20, GIS Lab (BSB/331)
L02 Thursday 11:30 – 13:20, GIS Lab (BSB/331)

**Text**

**Suggested Readings**


In addition, journal articles will be occasionally assigned for reading.

A workbook is available on a cost-recovery basis [$15]. The workbook introduces the computing environment, including an introduction to R GeoDA and ArcGIS Pro. The workbook contains step-by-step examples of analysis for all the methods and techniques covered in class, using real world data sets.

**Evaluation**

Exercises (4 @ 5% each - completion mark) 20 %
Group Project 30 %
Midterm Examination 15 %
Final examination: 35 %
Total: 100 %

A portion of the evaluation will be based on one group project and a final presentation + participation. Students must provide their own data for the group project.

The midterm will be 50 minutes in length and cover the introductory topics and Point Pattern Analysis. The location of the test will be announced in class. The final examination is cumulative and will be scheduled during the regular examination period.

**Course guidelines and regulations**
1. **Contacting the instructor** – I plan to adhere to regular office hours as indicated in this outline, and you are encouraged to use this time to review material, clarify points or pursue issues. Outside of these hours I am available only by appointment. I check email regularly, but if mailing outside of regular business hours do not expect a response until the following business day. Please include your course code (i.e., one of EARTH SC, ENVIR SC or GEOG 4GA3) in your subject heading. Finally, I do not take technical questions over the phone.

2. **Avenue to Learn** – Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the Course Administrators.

3. **Course preparation** – Be advised that in general you will be required to dedicate at least 3 hours of preparation/study per hour of class/lab time. More preparation will help you to make out the most of the course, and will undoubtedly lead to a higher grade. If for any reason you are having trouble with the course come and see me or any of the teaching assistants as soon as possible. Problems that are identified early can often be rectified.

4. **Formation of project teams** – To be discussed in introductory class.

5. **Handing in the deliverables** – Assignments are collectively worth 20% of the final grade. The assignments should be handed to your TA or IA at the beginning of the lab slot on the due dates indicated. If they are not submitted at the beginning of the session, they are considered late, and must be submitted to the Assignment Drop Box on the 2nd floor of GSB. This box is just outside the School of Geography and Earth Sciences Main Office. Late assignments are penalized at the rate of one letter grade for each day they are overdue, including weekends. This means that the first day it is late the penalty will be 20%, and then 10% each subsequent day.

6. **Peer review** – To be discussed in introductory class.

7. **Mark appeals** – The TA and I will make every effort to provide you with a grade that best reflects the quality of your work, and re-marking will be conducted at discretion. If you wish to have your work (project, examinations, etc.) re-marked, you will be asked to explain in writing, within at most 15 days after the work is initially returned, the reasons why it should be re-reviewed and the mark changed by the instructor or the IA. The first person to contact for clarification is the person who marked the work. A reply will be forthcoming in a period of at least 24 hours. Please note that re-marking may result in a higher or a lower grade. For problems with addition, your TA will make the adjustment for you without a written request.

8. **Students with special needs** – If you have (or suspect you may have) a learning disability that may require accommodations, you are advised to contact the Centre for Student Development (McMaster University Student Centre B107, Tel. 905-525-9140, ext. 28652). Accommodations are arranged exclusively through Disability Services (http://sas.mcmaster.ca/).

9. **Missed work or requesting extensions** – If you are seeking relief for missed academic work because of a minor medical reason lasting less than five days in duration, you may report your absence, once per term, without documentation, using the McMaster Student Absence Form. https://pinjap01.mcmaster.ca/msaf/. When using the MSAF, report your absence to delucapf@mcmaster.ca. Absences lasting more than five days must be reported to the Associate Dean’s Office (KTH 129 for Social Science students and BSB 129 for Science students) and appropriate documentation must be provided. For medical absences, the University reserves the right to require students to obtain medical documentation from the Campus Health Centre. Please note that the MSAF
form is simply a request for relief, the nature of the relief is left to the instructor’s discretion. Once the form is filled out, the student must contact the instructor by email or phone (paezha@mcmaster.ca, x26099) as soon as possible in order to make necessary arrangements for making up work. Generally, the accommodation will be to grant an extension which matches the length of the absence. If, however, assignments have been handed back, then the instructor will create an alternative, but comparable assignment for you to complete.

10. **Academic dishonesty** – All students are reminded of the seriousness of academic dishonesty. Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of a academic dishonesty please refer to the Academic Integrity Policy (specifically Appendix 3, located at [http://www.mcmaster.ca/senate/academic/ac_integrity.htm](http://www.mcmaster.ca/senate/academic/ac_integrity.htm)). Plagiarism (e.g. the submission of work that is not one’s own or for which other credit has been obtained) and copying or using unauthorized aids tests and examinations are examples of academic dishonesty.

11. The University reserves the right to change any aspect of this course outline

**Lab and Software Ownership Policies:**
As part of this course, you will complete assignments using ArcGIS Pro. McMaster University has obtained an academic site license from ESRI Canada Limited, which means that the license limits the use of the software to academic purposes only (i.e., you cannot use it for commercial purposes). Students who wish to have a student version of ArcGIS Pro can obtain one for a $30 administrative fee. This version of the software has the same functionality as the version in the GIS Labs and it expires after one year.

Although you will retain ownership of the rights to any original work you create while completing your assignments, you will have no rights after submission of the assignments to use ArcGIS in the GIS Labs. Further GIS work will require you to either work in the Map Library in Mills or obtain a license or permission to use such software from ESRI or a licensed distributor (unless you have purchased the student edition of ArcGIS).

In addition to the use of ArcGIS, you are advised that the data used in the course for the preparation of assignments may be subject to the proprietary rights of others. You must obtain appropriate permissions to use any such data for purposes other than the completion of assignments.

You are urged to discuss any concerns that you may have with your instructor. In no event will McMaster University be responsible for the use by a student of any data for which appropriate permission was not obtained. By taking part in this course, you agree to indemnify McMaster University from any loss that may be suffered on its part as a result of you not obtaining appropriate permission.
Tentative lecture schedule and calendar of events (subject to change at the discretion of the instructors)

**WEEK 1**
- **January 8**: Course Overview
- **January 10**: Introduction to Statistical Maps
- **Readings**: NO READINGS THIS WEEK
- **Labs**: Introduction to ArcGIS Pro and R

**WEEK 2**
- **January 15**: Introduction to Statistical Maps II
- **January 17**: Maps as Processes
- **Reading**: O’Sullivan & Unwin, 1-4
- **Labs**: Introduction to ArcGIS Pro and R II
- **Deliverable**: Group Work Contracts Due by Friday, January 19th @ 4:30PM in Drop Box

**WEEK 3**
- **January 22**: Point Pattern Analysis I
- **January 24**: Point Pattern Analysis II
- **Reading**: O’Sullivan & Unwin, 5
- **Labs**: Point Pattern Analysis I
- **Deliverable**: Exercise 1 due at the beginning of lab

**WEEK 4**
- **January 29**: Point Pattern Analysis III
- **January 31**: Point Pattern Analysis IV
- **Reading**: O’Sullivan & Unwin, 5
- **Labs**: Point Pattern Analysis II, Exercise 1 return and discussion

**WEEK 5**
- **February 5**: Area Data I
- **February 7**: Area Data II
- **Reading**: O’Sullivan & Unwin, 5 - 6
- **Labs**: Point Pattern Analysis III
- **Deliverable**: Literature Review Due, Friday February 9th @ 4:30PM in Drop Box

**WEEK 6**
- **February 12**: Area Data III
- **February 14**: Area Data IV
- **Reading**: O’Sullivan & Unwin, 7 - 8
- **Labs**: Area Data I
- **Deliverable**: Exercise 2 due at the beginning of lab

**WEEK 7**
- **February 19**: READING WEEK: NO CLASSES
- **February 21**: READING WEEK: NO CLASSES
- **Labs**: READING WEEK: NO CLASSES
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<tr>
<th>WEEK 8</th>
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<tbody>
<tr>
<td>February 26</td>
<td>Midterm Test</td>
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<td>February 28</td>
<td>Area Data V</td>
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<td>Labs</td>
<td>Area Data II, Exercise 2 return and discussion</td>
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<th>WEEK 9</th>
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<tbody>
<tr>
<td>March 5</td>
<td>Area Data VI</td>
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<td>March 7</td>
<td>Spatially Continuous Data I</td>
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<tr>
<td>Reading</td>
<td>O’Sullivan &amp; Unwin, 9 - 10</td>
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<tr>
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<td>Area Data III</td>
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<td>Spatially Continuous Data III</td>
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<td>March 19</td>
<td>Spatially Continuous Data IV</td>
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<td>March 21</td>
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<td>Reading</td>
<td>O’Sullivan &amp; Unwin, 9 - 10</td>
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<td>Spatially Continuous II, Exercise 3 return and discussion</td>
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<td>March 28</td>
<td>Group Presentations</td>
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<td>Labs</td>
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<td>April 2</td>
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<td>April 4</td>
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<tr>
<td>April 9</td>
<td>Exercise 4 return and discussion, Course Wrap Up</td>
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