Advanced Quantitative Methods (JPG 1400)
Fall Semester 2018
Department of Geography and Planning
Professor Michael J. Widener

Class Schedule

Fall Term 2018
Ramsey Wright Rm 107
Thursdays 12pm-3pm

Contact Details

Office hours: Thurs. 3:30-4:30pm
Email: michael.widener@utoronto.ca
Course Website: Quercus

Course Description

Spatial Analysis consists of a set of techniques used for statistical modeling and problem solving in Geography, Urban Planning, and other social and physical sciences. As such, it plays an integral role in the detection of spatial processes and the identification of their causal factors. It is a key component in one's preparation for applied or theoretical quantitative work in GIScience, Geography, and other cognate disciplines. Space, of course, is treated explicitly in spatial analytical techniques, and the goal of many methods is to quantify the substantive impact of location and proximity on human and environmental processes.

This course is not meant to serve as an introductory or refresher course in statistics for graduate students but it is for graduate students who wish to use spatial regression techniques in their theses and dissertations. The course is meant to provide advanced training in a range of regression techniques (multivariate regression, generalize linear models, and spatial regression), a foundation in the rigorous and mathematical treatment of regression approaches, and awareness of other commonly utilized quantitative methods in geography. Through this, students will be provided with the ability to continue their acquisition of knowledge of, and practical abilities to perform, quantitative methods that are required by their own research agendas.

The specific topics covered in this course include: an introduction to R, simple and multivariate regression and diagnostics, generalized linear models and diagnostics, detection of local and global spatial autocorrelation, spatial econometric regression models, and models for capturing spatial heterogeneous processes such as Geographically Weighted Regression.

The course will be offered in a computer lab setting, with a 3-hour weekly session mixed between formal lectures and applied lab-work on the computers. By the end of the course, students will be able to:

- understand the particular pitfalls and benefits of analyzing spatial data;
- appropriately select, apply, and interpret advanced spatial statistical techniques;

- accurately identify and remediate spatial effects in geographic regression processes;
- confidently use the R environment for spatial statistical computing, modelling, and visualization;
- critically interpret results from a range of advanced quantitative methods used in academic and applied geography and planning research.

Suggested Preparation

Students should have a strong background in inferential statistics and some experience with geographic information systems. Prior scripting experience will be an asset, but not required.

Readings

The course will draw from a collection of free texts, manuals and academic articles designed to inform students on the implementation and theory behind the methods covered.

1. [BPG] Bivand, R.S., Pebesma, E.J. and V. Gomez-Rubio (2008) Applied Spatial Data Analysis with R. Springer Online DOI: 10.1007/978-0-387-78171-6. Digital version available via U of T's library.

2. [SS] Sheather, S.J. (2009) A Modern Approach to Regression with R. Springer Online DOI: 10.1007/978-0-387-09608-7.

3. [R] An Introduction to R. http://cran.r-project.org/doc/manuals/R-intro.html.

4. Additional materials identified in the course schedule below.

Evaluation

5 Lab Assignments	40%
Research Project	60%

Lab Assignments: There will be 5 lab assignments due about every 2 weeks corresponding to the lecture material. Grades will be assigned based on completion, with each lab receiving a half grade (4 out of 8 percentage points) for partial completion and a full grade (8 percentage points) for full completion. To receive the full grade, students must provide thoughtful and complete responses to all questions asked.

Research Project: The final project is the largest grade component of the course. Deliverables include a project proposal (1 page, 10%, Oct. 4), descriptive data analysis (500 words excluding tables and figures, 10%, Oct. 25), and the final report (2000-3000 words not including figures and tables, 12 pt. font, double spaced, 40%, Dec. 9). Students will demonstrate their knowledge of the course material through the application of methods in an applied research project.

Students will be responsible for acquiring their own datasets, ensuring their suitability through communication with the professor, and conducting and reporting on their analyses in the final report. More details will be provided in class.

Schedule

Date	Topic	Lab	Reading
Sept. 13	Course Introduction	R Basics	[R] Chapter 1 and Appendix A
Sept. 20	Simple Regression	Lab 1: Simple Regression	[SS] Chapter 2
Sept. 27	Regression Diagnostics	Lab 1: Simple Regression	[SS] Chapter 3
Oct. 4	Multivariate Regression	Lab 2: Multivariate Regression	[SS] Chapter 5
Oct. 11	Multivariate Diagnostics	Lab 2: Multivariate Regression	[SS] Chapters 6,7
Oct. 18	Generalized Linear Models	Lab 3: Logistic Regression	[SS] Chapter 8
Oct. 25	NO CLASS	Lab 3: Logistic Regression	[SS] Chapter 8
Nov. 1	Logistic Regression/Spatial Autocorrelation	Lab 4: Spatial Autocorrelation	[SS] Chapter 8, [BPG] Chapter 9
Nov. 8	Reading Week		
Nov. 15	Local Spatial Autocorrelation	Lab 4: Spatial Autocorrelation	[BPG] Chapter 9, A2, A3
Nov. 22	Spatial Econometrics	Lab 5: Spatial Econometrics	[BPG] Chapter 10
Nov. 29	Spatial Expansion	Lab 5: Spatial Econometrics	A4
Dec. 6	Spillover / Final Projects		

Additional readings used in the schedule:

- [A1]: Logistic Regression Reading (TBD)
- [A2]: Getis, A. and K. Ord (1992). “The Analysis of Spatial Association by Use of Distance Statistics”. *Geographical Analysis* **24**, 189–206.
- [A3]: Anselin, L. (1995). “Local Indicators of Spatial Association – LISA”. *Geographical Analysis* **27**(2), 93-115.
- [A4]: Casetti, E. (1972). “Generating Models by the Expansion Method: Applications to Geographical Research”. *Geographical Analysis* **4**(1), 81-91.

Students are encouraged to use additional resources to complete their studies where necessary.

- Anselin, L. 1988. Spatial Econometrics: Methods and Models. Kluwer: Dordrecht.
- Cliff, A.D. and J.K. Ord. 1973. Spatial Autocorrelation. Pion: London.

- Cliff, A.D. and J.K. Ord. 1981. Spatial Processes: Models & Applications. Pion: London.
- Fotheringham, A.S. Brundson, C. and M. Charlton. 2003. Geographically Weighted Regression: The Analysis of Spatially Varying Relationships. John Wiley & Sons.
- Greene, W.H. 2011. Econometric Analysis, 7th Edition. Pearson.
- LeSage, J. and R.K. Pace. 2009. Introduction to Spatial Econometrics. Taylor and Francis: New York.
- Brunsdon, C., Fotheringham, S. and Charlton, M. (1998). "Geographically weighted regression". *Journal of the Royal Statistical Society: Series D (The Statistician)* **47**(3), 431-443.

Lateness and Submissions Policy
Except in the case of personal or medical emergencies, work must be submitted on time. Extensions may be permitted on a case-by-case basis through consultation with the instructor. Late assignments, proposals or term papers will be docked 10% per day, including weekends. All assignments and homework will be submitted via the course website.

Accessibility Needs
The University of Toronto is committed to accessibility. If you require accommodations for a disability, or have any accessibility concerns about the course, the classroom or course materials, please contact Accessibility Services as soon as possible: http://studentlife.utoronto.ca/accessibility

Academic Integrity
Plagiarism is an academic offense at the University of Toronto. Plagiarism is quoting (or paraphrasing) the work of an author (including the work of fellow students) without proper use of citation (and quotations marks when using an author's words). Students also should not be submitting any academic work for which credit has previously been obtained or is being sought, without first discussing with the instructor. Please consult the "Rules and Regulations" section of the Arts and Science Calendar (http://www.artsandscience.utoronto.ca/ofr/calendar/Rules_&_Regulations.html) for further information and check the 'How not to plagiarize' website at: http://www.writing.utoronto.ca/advice/using-sources/how-not-to-plagiarize.