GEOG 351: QUANTITATIVE METHODS

McGill University, Department of Geography

Winter 2019

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Lectures: Tuesdays and Thursdays, 10:05 – 11:25 am (Burnside Hall 306)
Office Hours: Thursdays, 2:30 – 3:30 pm or by appointment (Burnside Hall 417)
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Course Description and Objectives

This course is designed to provide students with an understanding of key statistical methods used by geographers. After reviewing basic statistical techniques, emphasis is placed on regression analysis, its underlying assumptions and problems associated with violations of these assumptions. The course also explores alternative forms of multivariate analysis and introduces students to spatial regression models and the analysis of times series data.

Students will gain practical experience working with data and statistical software packages (*STATA* and *GeoDa*) in lab sessions (see section on computer software and the GIC educational lab below). Class attendance and participation to these lab sessions is required.

In terms of prerequisites for this course, it is assumed that students have some prior knowledge of introductory statistics and are comfortable with basic mathematical conventions and notation.

Required Text

The following text book is required and can be purchased at the McGill University Bookstore.

Rogerson, P. 2015. *Statistical Methods for Geography – A student's guide*. 4th ed. Thousand Oaks, CA: SAGE.

You will find the book's companion website (www.study.sagepub.com/rogerson4e) useful as it includes the datasets used for the examples contained in each chapter, as well supplementary datasets and answers to selected exercises.

Additional References

In addition to the required textbook, readings will be drawn from the following references. Most of these references are available at the Schulich (Science and Engineering) or McLennan (Humanities/Social Sciences) libraries.

Acock, A. C. 2006. *A gentle introduction to Stata*. College Station, TX: Stata Press.

Burt, J.E., G.M. Barber and D.L. Rigby. 2009. *Elementary statistics for geographers*. 3rd ed. NY: Guilford Press.

Clark, W.A.V. and P.L. Hosking. 1986. *Statistical methods for geographers*. NY: Wiley.

Ebdon, D. 1985. *Statistics in geography*. 2nd ed. New York, NY: Blackwell Publishers.

Gujarati, D.N. 1995. *Basic econometrics*. 3rd ed. New York, NY: McGraw-Hill.

Mitchell, A. 1999. *The ESRI guide to GIS analysis*. *Volume 2.* Redlands, CA: ESRI Press.

Shaw, P. J. A. 2003. *Multivariate statistics for the environmental sciences*. London: Hodder Arnold.

Stock, J. H. and M. W. Watson. 2007. *Introduction to econometrics*. NY: Pearson Addison Wesley.

Ward, M. D. and K. S. Gleditsch. 2008. *Spatial regression models*. CA: Sage Publications.

Wheelan, C. 2013 *Naked statistics: Stripping the dread from the data*, W.W. Norton & Company.

Links to useful statistical resources and data archives will also be provided on myCourses.

Computer Software and GIC Lab

One of the goals of the course is to get you working with various computer software packages in order to gain hands-on experience with statistical analyses, manipulation of spatial datasets and the interpretation of results. Lab assignments in this course are to be performed with *STATA* (IC 15.0) and *GeoDa* (Version 0.9.x). *STATA* is a multi-purpose statistical software package whereas *GeoDa* is a specialized software used for spatial data analyses. Both are menu-driven and currently available on all computers in the GIC educational lab on the 5th floor of Burnside Hall.

Students registered in the course automatically receive a login code and password for these computers. Because of the restricted number of computers in the GIC lab, you are asked to limit use of these machines to working with *STATA* and *GeoDa*. For all other applications (i.e. word processing, e-mail and/or surfing the web), please use the machines located in the outer part of the GIC lab.

Students are also encouraged to consult McGill's Library website for (www.mcgill.ca/library/find/edrs) for information on datasets that are available electronically and on-site assistance using *STATA* and other statistical software such as *StatTransfer*.

Course Evaluation and Grading Policy

Your overall performance in the course is determined as follows:

Tests / Assignments	Value
Lab assignments	25 %
Mid-term (Thursday, February 28th)	25 %
Final short research paper and presentation	20 %
Final exam	30 %

Lab assignments consist of a series of problems assigned by the instructor. Write-ups for lab assignments must be individual and reflect your own work. Unless otherwise indicated, lab assignments will be due in class one week after they are handed-out. Late assignments will not be accepted unless students have a certified medical reason. The same policy applies for make-up exams.

The final project consists of a short research paper and presentation. Students must find a suitable dataset and carry out their own analysis using statistical techniques introduced in class. Collaborations between two individuals are encouraged for the final project (more details to follow) and presentations are scheduled for the final two weeks of class. *In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded*.

Academic Integrity

McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/ for more information).

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Course Outline / Reading Assignments

Note that the course content outlined below may vary depending on our progress through the material in class and extensions of related arguments during lab sessions. Required readings are identified with an asterisk.

1. Review of Basic Statistical Concepts in Geography

Key topics: some preliminary definitions, general descriptive statistics (measures of central tendency and dispersion), descriptive statistics for spatial data

Readings: * Rogerson, P. 2015, chapters 1 and 2
Burt, J.E., G.M. Barber and D.L. Rigby. 2009, chapters 1 – 3
Clark, W.A.V. and P.L. Hosking. 1986, chapter 6

2. Elements of Inferential Statistics

Key topics: frequency and probability distributions, principles of point and interval estimation (confidence intervals), hypothesis testing

Readings: * Rogerson, P. 2015, chapters 3, 4 and 5
Burt, J.E., G.M. Barber and D.L. Rigby. 2009, chapters 5, 7, 8 and 9
Clark, W.A.V. and P.L. Hosking. 1986, chapter 7

3. Analysis of Variance

Key topics: comparing the means of three or more samples, homoscedasticity

Readings: * Rogerson, P. 2015, chapter 6
Burt, J.E., G.M. Barber and D.L. Rigby. 2009, chapter 11

4. Correlation Analysis

Key topics: covariance and correlation, Pearson's product-moment correlation coefficient, Spearman's rank correlation coefficient

Readings: * Rogerson, P. 2015, chapter 7
Burt, J.E., G.M. Barber and D.L. Rigby. 2009, parts of chapter 4
Burt, J.E. and G.M. Barber. 1996, chapter 12

5. Simple (Two-Variable) Linear Regression Analysis

Key topics: assumptions of linear regression models, ordinary least squares, interpretation and assessment of the simple linear regression model (i.e. goodness of fit), graphical diagnostics

Readings: * Rogerson, P. 2015, chapter 8
Burt, J.E., G.M. Barber and D.L. Rigby. 2009, parts of chapters 4 and chapter 12
Gujarati, D.N. 1995, chapters 1 – 3, 5

6. Multiple Regression Analysis

Key topics: interpretation of multiple regression equation, the meaning of partial regression coefficients, beta weights, selecting independent variables

Readings: * Rogerson, P. 2015, chapter 9
Burt, J.E., G.M. Barber and D.L. Rigby. 2009, parts of chapter 13
Gujarati, D.N. 1995, chapter 7

7. Extensions of the Linear Regression Model and Issues in its Application

Key topics: functional forms, transformations, analysis with dummy variables, multicollinearity, heteroscedasticity and validation

Readings: * Rogerson, P. 2015, parts of chapter 9
Burt, J.E., G.M. Barber and D.L. Rigby. 2009, parts of chapter 13
Gujarati, D.N. 1995, parts of chapters 6, 9 – 12

8. Spatial Autocorrelation and Spatial Regression Models

Key topics: spatial dependence in geographic data, Moran's *I* statistic, local indicators of spatial association, controlling for spatial autocorrelation in regression models, geographically weighted regression

Readings: * Rogerson, P. 2015, chapters 10 and 11
Burt, J.E., G.M. Barber and D.L. Rigby. 2009, chapter 14
Ebdon, D. 1985, chapter 7
Mitchell, A. 1999, chapters 3- 5
Ward, M. D. and K. S. Gleditsch. 2008.

The Center for Spatial Data Science at the University of Chicago provides useful links to spatial learning resources and tools, including links to a free download of the latest version of *GeoDa* (https://spatial.uchicago.edu/software) and a detailed workbook containing step-by-step guidelines of the various features found in *GeoDa*.

9. Regression Models Based on Qualitative Response Variables

Key topics: categorical dependent variables, linear probability models, logit models, interpretation

Readings: * Rogerson, P. 2015, parts of chapter 9
Gujarati, D.N. 1995, parts of chapter 15
Clark, W.A.V. and P.L. Hosking. 1986, chapter 13

10. Special Topics I: Factor and Principal Components Analysis

Key topics: data reduction techniques, factor loadings, interpretation, cluster analysis

Readings: * Rogerson, P. 2015, chapter 12
Shaw, P. J. A. 2003, chapter 6
Johnston, R.J. 1978, chapter 5

11. Special Topics II: Questionnaire and Sampling Designs

Key topics: sampling design, survey types, some issues to consider

Readings: * Burt, J.E., G.M. Barber and D.L. Rigby. 2009, chapter 6
Wild, C. and G. Seber. 2000, parts of chapter 1