GGS 300 Quantitative Methods for Geographical Analysis

Spring 2016 Mondays and Wednesdays 12:00-1:15 pm, Exploratory 2103

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Office Hour: Mondays 11am - noon, and Tuesdays 5-6 pm, or by appointment

Catalog Description

Comprehensive introduction to quantitative methods in spatial analysis, with emphasis on solving geographical research problems. Topics include nature of spatial data; collection of spatial data; preparation of spatial data for mapping, geographic information systems, and statistical analysis; descriptive spatial statistics; areal sampling theory and methods; probability theory and distributions; hypothesis testing; correlation and regression; and areal and point pattern spatial statistics.

Students as Scholars Requirements

GGS 300 is a *Students as Scholars* Scholarly Inquiry course. Students will learn about the broader process of conducting research in geography and geoinformation science. Students will learn that statistical testing and quantitative approaches are used to not only provide answers, but also to refine research questions and generate new questions, ideas, and hypotheses. This course will prepare students to conduct original, scholarly research. Specifically, students will:

- Articulate and refine a research question
- Follow ethical principles in research
- Choose the appropriate process, approach, or methodology for scholarly inquiry
- Situate the scholarly inquiry within a broader context

Objectives

The purpose of this course is to introduce ***basic*** statistical and quantitative techniques for analyzing spatial data. Due to the unique nature of spatial data, traditional (or classical) statistics are not competent and adequate for geographical research, and thus spatial statistics are introduced. This course provides only an ***overview*** of quantitative techniques/spatial statistics commonly used by geographers, and will focus on different statistical techniques for different types of geographical features. By finishing this course, students **begin** to appreciate the issues involved in choosing appropriate statistics, primarily spatial and to a lesser extent, aspatial, to deal with some common problems in geographical research.

A good comprehension of algebra and basic trigonometry will be helpful in this course. Knowing GIS will be useful, but is not a must. *Using examples to illustrate the use of statistics is effective, but time will not allow us to go through many examples in class. Thus students are expected to look for application examples in areas that they are interested in or familiar with. Reading the corresponding sections in the textbook will surely help.* The course will cover only univariate and bivariate statistics. More advanced topics in multivariate statistics and spatial statistics, such as kriging/spatial interpolation, higher-orders point pattern analyses, and spatial regressions or spatial econometric models shall be discussed in advanced course(s).

To meet the course work requirements, Microsoft Excel may be more useful than using a standard statistical package, such as SPSS, Students may also choose to use other statistical packages. A ***hand calculator*** (statistical functions are not required) would be handy.

Learning Outcomes

Knowledge:

- Aware of the fundamental characteristics of spatial data and the reasons for using spatial techniques
- Knowledge about the procedure for hypothesis testing and conducting basic statistical tests
- Differentiate basic spatial sampling methods and understand descriptive spatial statistics

Skills:

- Differentiate different types of spatial data in order to determine the type of appropriate spatial statistics
- The ability to formulate statistical hypotheses and execute the testing procedures

Text: Wong, D. W. S. and J. Lee (2005) *Statistical Analysis of Geographic Information with ArcView GIS and ArcGIS*. Wiley.

Other references:

Burt, J. E., G. M. Barber, and D. L. Rigby. 2009 *Elementary Statistics for Geographers*, Guilford.

Lloyd, C. 2010 *Spatial Data Analysis: An Introduction for GIS users*. Oxford.

McGrew, J. C., A. J. Lembo and C. B. Monroe. 2014. *An Introduction to Statistical Problem Solving in Geography*. Waveland Pr Inc.

Assessment

Coursework: Four/Five exercises (not equally weighted)

* 10% of the original scores will be deducted **each day** if they are turned in late. All exercises are due in class in hard copies (no online/email submission will be accepted, unless specified). **Students are required to show intermediate steps and values of calculation in order to receive credits** (you are not required to type your answers).

Reading Requirements

1) Chapter 6, Data Management Practices (in Steneck 2007 – in Blackboard)
2) Chapter 8, Collaborative Research (in Steneck 2007 – in Blackboard)
3) The Ethics of Scientific Collaboration
   http://blogs.discovermagazine.com/neuroskeptic/2015/06/21/scientific-collaboration/

Topics:

1) Introduction (Ch.1):
   - Why Statistics and Sampling?
   - Spatial Data and their Problems
   - The need for Spatial Statistics
   - Basics: notations, algebra, trigonometry, scale of measurement, errors
2) Descriptive classical statistics: univariate (Ch.2)
   - central tendency, dispersion, higher moments
3) Descriptive classical statistics: bivariate (Ch.3)
   - Correlations (nominal, ordinal and interval/ratio)
   - Simple linear bivariate regression
4) Descriptive Centrographic Measures for Points (Ch. 5)
   - Central tendency, dispersion and orientation
5) Basis for Inferential Statistics (Ch. 4)
   - Probability theory, distributions, functions and hypothesis testing
   - Testing of variances and means
   - Testing of nonparametric statistics
6) Point Pattern Analysis (Ch. 6)
   - Quadrat analysis
   - Nearest Neighbor statistics
7) Spatial autocorrelation: Polygon data (Ch. 8)
   - Spatial Weights Matrices
   - Join Count Statistics (Nominal)
   - Global Statistics (Moran's I, Geary Ratio, G-statistic)
   - Local Statistics (LISA and Local G)