POS 6743: Geographic Tools for Political Science Research

Mondays 6:00pm – 8:50pm - HPH O409 - Fall 2018

Instructor: Konstantin Ash (Konstantin.Ash@ucf.edu) Office Hours: M 3-5p, F 1-3p @ HPH 311A

Course Description

The manipulation and analysis of geographic data is an increasingly important skill in both academic political science and in private and public sector employment. The goal of this class is to provide an introduction to geographic data and various programs used to both create, examine, alter and analyze geographic data, including ArcGIS, R and Google Earth Engine. Students will be introduced to ways of both creating data-sets with geographic components and extracting geographic data from existing geo-coded sources.

The course is divided into three parts: the first part will cover basic data manipulation in ArcGIS, the second will introduce remote sensing through Google Earth Engine and the third will introduce R as a way of extracting and manipulating geographic data, conducting statistical analysis through regression and accounting for space in regression analysis. No prior knowledge of any statistical or programming language or statistical analysis is required for the course and at least one week will be devoted to teaching each concept/program.

As this is a master's level class, there will be an inferential research component to the course. In that, you will be required to gather your own geographic data and analyze it using statistical methods to test a relationship of your choice. There are deadlines throughout the course, ranging from submission and approval of the research topic to submission of the data to be used in the project in advance.

Assignments

Homework Assignments

There are five homework assignments due throughout the semester, at the beginning of the class noted on the course schedule, unless stated otherwise. Each will be non-cumulative examinations of recently taught skills. Homework assignments will be assigned 1-2 weeks before they are due. Each assignment will be worth 10% of the final class grade.

Research Paper

The research paper will be a way of combining each of the three sections of the course into one cohesive project. The requirements are to 1) have a research question that can be answered through the use of geographic data, 2) include data obtained both through standard rasters and/or shapefiles and through remote sensing using Google Earth Engine 3) utilize inferential statistics covered in the last third of the class to test for a significant relationship using the geographic data and including methods to account for the geographic nature of the data in a statistical model.

The research paper does not need to be fully fleshed out and need not include an extensive literature review or theory section - there should just be enough to give the reader an idea of why the research question is important and needs to be answered and how this study differs from previous efforts to answer the question. However, it does need to clearly present a research design that shows understanding of statistical analysis, a justification of the data used in the statistical analysis with a clear narrative about how the data was obtained, and a clear presentation of the results of the analysis. Visualizations, including maps that illustrate either descriptive or inferential statistical findings should be included whenever possible. These visualizations should be clear and expand a reader's understanding of your subject and design. The paper will be graded on the extent to which these components are successfully executed. There is no maximum or minimum page limit.

In addition to the paper, students are required to submit replication code for any work they have done on the paper in R and Google Earth Engine, including data extraction and analysis, as a supplemental file to the paper submission.

A prospective research question for the paper and a description of relevant data to be extracted using ArcGIS/R is due on October 8 and a description of relevant data to be extracted through Google Earth Engine on November 5, both before the beginning of each day's class. The research paper is due on **Saturday, December 8, 2018 @ 12:00pm**.

Presentation

Students are required to present their research paper on the last day of class (November 26, 2018). The paper does not need to be written, but the bulk of data-gathering and statistical analysis should be completed by that time. The gap between the presentation and when the paper is due is designed so that students may receive feedback on their work and then address that feedback before the final paper is due

Plagiarism

There is a ZERO tolerance policy on plagiarism. If you are found having copied any substantial portion of your paper from other sources without having first accredited them, you will either have large amounts of points deducted from your paper grade or will fail the class altogether. Please consult the UCF Office of Student Conduct's Rules of Conduct for more information.

Required Computer Programs

The readings for the class will be posted on WebCourses. There will be three required computer programs that you must either download to your personal computer or use in the computer labs. It will make your life a lot easier to get these on your personal computer.

- **R** - a statistical computing program, which can both visualize and analyze geographic data and maps. Download R here: https://cran.r-project.org/bin/windows/base/. Download R Studio, a very helpful wrapper for the R GUI here: https://www.rstudio.com/
- **Google Earth Engine** - Google's means of analyzing geographic data through Google Earth, includes a large data-base of spatial maps from remote sensing sources. Access the explorer, which is a drop-down menu-type program, here: https://explorer.earthengine.google.com/workspace and the Code Engine here https://code.earthengine.google.com/. You need to request access beforehand to use the code engine. It is also helpful to download Google Earth Pro for your personal computer as it handles .kml files well: https://www.google.com/earth/download/gep/agree.html.
- **ArcGIS** is our only paid app. It is available in this computer lab and the one on the third floor. There may be others on campus. I have also already contacted you about a free student version that you can place on your personal computer for one year. Please talk to me if you have not heard anything.
- **Google Earth Pro** - Google's visualization app for desktops. Available for free download here. We will use it for file conversion only, but it is a useful hobby-mapping program.

Grade Breakdown

Research Paper – 40%
Five Homework Assignments – 10% each
Presentation – 10%

Course Schedule and Readings

Week 1 (August 20) - Introduction, Geographic Research and its use in political science

Topics Covered:

- Rationale for learning geographic data analysis
- Definitions: shapefiles, rasters georeferencing
- Importing shapefiles and rasters into ArcGIS
- Importing tabular data into ArcGIS
- Geocoding rasters from non-georeferenced image data

Reading:

- Wilpen L. Gorr and Kristen S. Kurland. GIS Tutorial 1 Basic Workbook. ESRI Press (2010) Ch. 1

- David W. Allen and Jeffery M. Coffey. GIS Tutorial 3 Advanced Workbook. ESRI Press (2010) Ch. 4

Software: ArcGIS

Week 2 (August 27) - Feature Analysis

Topics Covered:

- Creating features from raster data
- Feature Analysis: buffer, intersect, clip, project, dissolve, etc.

Reading:

- Wilpen L. Gorr and Kristen S. Kurland. GIS Tutorial 1 Basic Workbook. ESRI Press (2010) Chs. 8-9.

Software: ArcGIS

Week 3 (September 10) - Zonal Statistics

Topics Covered:

- Extracting Zonal Statistics from rasters using shapefiles
- Raster analysis and manipulation

Reading:

- Wilpen L. Gorr and Kristen S. Kurland. GIS Tutorial 1 Basic Workbook. ESRI Press (2010) Ch. 11

Software: ArcGIS

Homework 1 Assigned

Week 4 (September 17) - Raster Interpolation and Map Design

Topics Covered:

- Raster interpolation
- Designing informative maps in ArcGIS

Reading:

- David W. Allen and Jeffery M. Coffey. GIS Tutorial 3 Advanced Workbook. ESRI Press (2010) Ch. 9

Software: ArcGIS

Week 5 (September 24) - Introduction to Remote Sensing and Remotely Sensed Data

Topics Covered:

- Definition of Remote Sensing
- Key terms regarding projections bands and sensors
- Differences in satellites: LOA vs. MODIS vs. Landsat.
- Opening layers in Google Earth Engine Explorer
- Basic analysis of layers using GEEE.
- Topography and map-making from remotely-sensed data.

Reading:

- Lillesand, Thomas M., Ralph W. Kiefer and Jonathan W. Chipman. Remote Sensing and Image Interpretation. Hoboken, NJ: John Wiley and Sons. pp. 330-486.
- James B. Campbell and Randolph H. Wynne. Introduction to Remote Sensing. New York and London: The Guilford Press. Ch. 11.

Software: Google Earth Engine Explorer

Homework 1 Due before start of class

Week 6 (October 1) - Remote Sensing With Google Earth Engine

Topics Covered:

- Crash course in JavaScript
- Extracting layers in GEE API.
- Mathematical operations in GEE API.
- Image collections and extraction
- Reducing and Masking

Software: Google Earth Engine API, Google Earth Pro.

Homework 2 Assigned

Week 7 (October 8) - Google Earth Engine API Continued

Topics Covered:

- Creating features and Google Fusion Tables
- Operations and commands using Google Fusion Tables
- Exporting image data from GEE API to ArcGIS

Software: Google Earth Engine API, Google Earth Pro.

Research Paper Part I: Research Question and Relevant Data extracted using ArcGIS/R due before class

Week 8 (October 15) - R Tutorial

Topics Covered:

- Basics of using R
- Variables: vectors, matrices.
- Functions: existing functions, making your own functions, loops, data manipulation.

Reading:

- R is an open-sourced program that amalgamates many user-made packages. Because the help files are incoherent to the layman and non-layman alike. Many people have made tutorials. Utilize at your own discretion.

Software: R - Install the latest version of R and RStudio on your personal computer.

Homework 2 Due before start of class

Homework 3 Assigned

Week 9 (October 22) - Geographic Data using R

Topics Covered:

- Inputing shapefiles and rasters into R
- Feature analysis in R
- Zonal statistics in R
- Making Maps in R

Reading:

- Roger S. Bivand, Edzer Pebesma, Virgilio Gomez-Rubio. 2013. Applied Spatial Data Analysis with R. Springer. 2nd ed. Chapters 3, 5 and 8.

Software: R

Week 10 (October 29) - Regression Tutorial

Topics Covered:

- Applications of regression analysis.
- BLUE, Least Squares, multivariate OLS regression.
- Violations of Regression Assumptions and what to do about it.
- Non-Linear regression models.

Reading:

Allison, Paul D. Multiple Regression: A Primer. Pine Forge Press. 1998. Whole thing, but focus on Chs. 1, 6 and 9.

Software: R

Homework 4 Assigned

Homework 3 Due before start of class

Week 11 (November 5) - Evaluating Spatial Dependence

Topics Covered:

- Interactions, fixed effects and clustered standard errors
- Methods of extracting neighbor information
- Creating spatially weighted matrices
- Methods of extracting neighbor information
- Evaluating dependence across data structures
- Relevant objects in R

Reading:

- Kristian Gleditsch and Michael Ward. 2007. An Introduction to Spatial Regression Models in the Social Sciences. Chapter 1.

Software: R

Research Paper Part II: Remotely Sensed Data and Description due before class

Week 13 (November 19) - Spatial Regression Models Part 1

Topics Covered:

- Moran's I statistic
- Spatially lagged regression models

Reading:

- Kristian Gleditsch and Michael Ward. 2007. An Introduction to Spatial Regression Models in the Social Sciences. Chapter 2.

Software: R

Homework 4 Due before start of class

Homework 5 Assigned - due November 30 @ 6pm (Research Paper Part III part of assignment)

Week 14 (November 26) - Taking Spatial Dependence into account in Regression

Topics Covered:

- Spatial error model
- Conley spatial errors
- Spatial dependence with panel data

Reading:

- Kristian Gleditsch and Michael Ward. 2007. An Introduction to Spatial Regression Models in the Social Sciences. Chapter 3.

Software: R

Week 14 (November 30) - In Class Presentations on Research Project

Homework 5 Due with presentations

Final Paper Due on Saturday, December 8, 2017 @ 12:00pm