# Geography (GEOG) 457/657: Open-Source Spatial Analytics
## (3 Credit Hours)
## Term Year

**Instructor:** Aaron E. Maxwell, PhD, GISP
**Class Time:**
**Class Location:**

**Office:**
**Hours:**
**E-Mail:** Aaron.Maxwell@mail.wvu.edu
maxwellgeospatial@gmail.com

**Course Webpage:**

All course content is available on the West Virginia View webpage:

http://www.wvview.org/ossa/Open_Source_Spatial_Analytics.html

**Professor Maxwell's Website:**

http://www.wvview.org/Prof_Maxwell.html

**Course Rationale:**

Analyzing geospatial data is a key component of GIScience and data analysis within the field of geography. The goal of this course is to introduce students to the free statistical software tool R and investigate the use of this software for working with data in general and geographic data in particular.

**Prerequisite**

Undergraduate students must complete Geography 300: Geographic Data Analysis **OR** Geography 350: GIScience with a grade of D- or higher before taking this course. There is no prerequisite for graduate students; however, students should be familiar with GIS and spatial analysis and should have completed a prior GIS course. No prior knowledge of R or the R coding language is assumed.

**Course Outcomes:**

By the end of this course, students will be able to:

1. prepare, manipulate, query, and generally work with data in R
2. perform data summarization, comparisons, and statistical tests
3. create quality graphs, map layouts, and interactive web maps to visualize data and findings
4. present your research, methods, results, and code as web pages to foster reproduceable research
5. work with spatial data in R
6. analyze vector and raster data to answer a question with a spatial component
7. make spatial models and predictions using regression and machine learning
8. code in the R language at an intermediate level

## Method of Instruction/Philosophy

The course outcomes for this class will be met using a combination of lectures, class discussions, coding demonstrations, and hands-on exercises. I firmly believe that students learn via engagement and by doing. It is important that you engage yourself during this class. I will do my best to help you learn; however, it is imperative that you take ownership of your own education.

## Textbook:

There is no required text for this course. However, we will make use of a variety of resources, many of which are free and openly available. Here is a list of useful resources:

- *R in Action* by Kabacoff (ISBN-10: 1935182390; ISBN-13: 978-1935182399)
- *An Introduction to Statistical Learning* by James, Witten, Hastie, and Tibshirani (http://faculty.marshall.usc.edu/gareth-james/ISL/)
- The Comprehensive R Archive Network: https://cran.r-project.org/
- RStudio Website: https://www.rstudio.com/
- Quick-R: http://www.statmethods.net/
- *R in Action* GitHub: https://github.com/kabacoff/RiA2
- GIS in R by Nick Eubank: http://www.nickeubank.com/gis-in-r/
- Intro to R for GIS and Spatial Analysis: https://mgimond.github.io/Spatial/index.html
- R Spatial: http://www.rspatial.org/
- *R Graphics Cookbook* by Winston Chang.
- *R: An Introduction to R for Spatial Analysis and Mapping* by Chris Brunsdon and Lex Comber.
- Note that all R packages have available documentation. We will make use of package documentation and cheat sheets throughout the semester.

## Grading:

Grading for this class will consist of 20 assignments and a term project. Some class time will be set aside to work on assignments, but you will also need to work on assignments outside of class time. Due dates are noted in the schedule below.

## Grade Point Distribution:

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|---|---|
| Exercises | 40 points each, 800 points total |
| Final Project | 200 points |
| **Total** | **1000 Points** |

## Grade Scale

| | | |
|---|---|---|
| 90%-100% | A | > 900 Points |
| 80%-90% | B | > 800 Points |
| 70%-80% | C | > 700 Points |
| 60%-70% | D | > 600 Points |
| 0%-60% | F | < 600 Points |

| Week | Topic | Activities | Due (By Beginning of Scheduled Class Time) |
|---|---|---|---|
| Week 1 | Syllabus, Introduction, R Set-Up, Coding Etiquette | | |
| Week 2 | R Language Part I/ Data Queries and Manipulation/ Working with Strings and Factors | A1 | |
| Week 3 | R Language Part II | A2 | **A1** |
| Week 4 | Data Summarization and Statistics/ R Markdown | A3/A4 | **A2** |
| Week 5 | Graphs with ggplot2 Part I | A5 | **A3/A4** |
| Week 6 | Graphs with ggplot2 Part II Tables with gt | A6/A7 | **A5** |
| Week 7 | Working with Spatial Data Maps with tmap | A8 | **A6/A7** |
| Week 8 | Additional Map Examples/ Interactive Maps with Leaflet | A9 | **A8** |
| Week 9 | Vector-Based Spatial Analysis | A10 | **A9** |
| Week 10 | Raster-Based Spatial Analysis (raster) Raster-Based Spatial Analysis (terra) | A11/A12 | **A10** |
| Week 11 | LiDAR and Image Analysis | A13 | **A11/A12** |
| Week 12 | Machine Learning Background/ Regression and Diagnostics | A14/A15 | **A13** |
| Week 13 | Random Forest | A16 | **A14/A15** |
| Week 14 | Machine Learning with caret | A17/A18 | **A16** |
| Week 15 | Machine Learning with caret/ Machine Leanrning with tidymodels | A19/A20 | **A17/A18** |
| Finals Week | **Turn in Term Project, A19, and A20** | | |

**Note:**

This schedule is subject to change based on the needs and pacing of the class.