

# Geographic Information Systems in R: Fundamentals and applications for ecologists

## SMSC 534

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**Instructor:**

Dr. Brian Evans

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**Dates, Meeting Times,  
and Location:**

22 August – 16 October  
2022

All content will be  
provided through  
Blackboard.

Two optional, hour-long  
virtual weekly meetings  
will be held each week:

Mon: 10:30 – 11:45 ET

Fri 10:45-11:30 am ET

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**Office Hours:**

Virtual office hours twice  
a week:

Thu 8:00-9:30 am ET

Fri 1:30-2:45 pm ET

*Format and logistics will be  
provided during the first  
week.*

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**This is an asynchronous online course. Each week, participants are expected to work through a set of instructional videos and associated exercises. Weekly problem sets are also required. Two optional live weekly sessions will provide time for: 1) discussion about content and assignments with the instructor and other participants and 2) instructor-led review of previous week's assignment.**

**Course Overview**

This asynchronous online course aims to provide participants with an introduction to the increasingly powerful and flexible range of tools for working with both vector and raster spatial data in the R environment. The course will review core GIS concepts and the basics of R programming and build skills in raster and vector import and manipulation. The course closely integrates tidyverse functions with GIS tools to develop efficient and intuitive coding. Special emphasis will be placed on visualizing spatial data through developing static and interactive maps. The first few weeks will be spent honing R coding skills, ensuring that you have the necessary understanding of modern data science workflows in R.

**Credits: 3**

**Prerequisites:** Prior experience with the R coding environment

**Participant Learning Outcomes**

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

- Read, project, and write shape & raster files in R
- Conduct spatial joins, geometric operations, and data extraction with geospatial files
- Conduct geospatial analyses (e.g., point pattern and network analyses)
- Create informative & visually appealing static and interactive maps
- Create interactive web applications for exploring geospatial data

### ***Format and Pacing***

As an asynchronous course, there is no set mandatory meeting time. However, participants interested in a certificate of completion **are** required to submit a subset of the weekly problem sets by a specified due date. Aside from this requirement, participants may view the instructional videos and work through associated exercises (see below) at their own pace.

### ***Instructional Videos and Exercises***

One to five instructional videos (10-45 minutes each) addressing the topics that are the focus of each week will be posted on Blackboard. The total length of instructional videos will vary by week, but is generally in the range of 1.5-2 hours. In addition, R code scripts with detailed guiding comments and R Markdown / html files are provided that demonstrate the analysis approaches covered that week. Including instructional videos and demonstration code, participants should expect to devote *approximately 4-8 hours per week* to this content (*Note: This estimate does not include time spent on readings or assignments*). The time required may be more or less, depending on your pace working through exercises and previous experience with R. Content for a given topic will be posted at least one week prior to the date listed on the schedule (e.g., Week 3 content will be posted prior to the beginning of Week 2).

### ***Online Discussion Board***

A discussion board will be hosted on Blackboard for participants to discuss the week's assignment, seek advice on approaches to a given question, and provide mutual assistance. This discussion board is a great place to find help with a problem, or to help out a classmate.

### ***Weekly Virtual Meetings***

Each week, two *optional* meetings will be hosted virtually. The first meeting (Mondays, 10:30-11:45 am ET) will be a review of the previous week's assignment, led by the instructor. Answer keys to the problem sets will be posted each Monday by 12am ET, giving participants time to review the key before the Monday review session. The second optional virtual session (Fridays, 10:45-11:30 am ET) will serve as an open question & answer period. For those that learn better by interacting with others, this "virtual classroom" provides an opportunity to do so. There will be time to ask questions on lecture content as well as the current week's assignment during this time. Questions addressed will be on a first come, first served basis. Both meetings will be recorded and posted on Blackboard for those that are unable to attend.

### ***Readings***

Specific required and suggested readings will be associated with each week's topic. Throughout the semester we will use a combination of peer-reviewed literature, online resources, tutorials developed for this course, and book chapters. All content will be provided on Blackboard via web links or pdf documents.

Our primary textbook for this course (optional):

Lovelace R., Nowosad J., and Muenchow, J. (2019). *Geocomputation with R* (1st ed.). Chapman and Hall/CRC. <https://doi.org/10.1201/9780203730058>. A free online version of this book is available at <https://geocompr.robinlovelace.net/>.

Suggested Reading: Wickham, H., & Grolemund, G. (2016). *R for data science: import, tidy, transform, visualize, and model data*. O'Reilly Media, Inc. A free online version of this book is available at <https://r4ds.had.co.nz/>.

### ***Pre-course Work***

Exercises in R will be assigned one month prior to the course and are required for all participants. These are designed to assist R beginners in getting a baseline familiarity with key R programming concepts. These also serve an important refresher for those already working regularly in R.

### ***Certificate Requirements***

Those interested to receive a formal certificate of completion for this course are required to complete and submit three of the seven weekly assignments, and the final problem, on time. Participants not requiring a certificate are not required to submit anything, though they may certainly do so. Because of the large number of participants in the course, feedback on each assignment may not be possible, but full answer keys will always be provided, and numerous sessions are available for questions to be answered and discussed.

### ***Problem Sets***

Weekly analysis assignments are due *every Sunday by 11:59pm ET*. Those participants interested in the completion certificate are required to complete at least 3 of the seven weekly problem sets. To be counted toward your certificate you must receive a non-failing score (7/10 pts). Submission of assignments will occur through Blackboard. ***Late assignments will NOT be accepted.*** Assignment introductions as well as solution keys will be presented as html and/or R Markdown files, including code, comments, and figures.

### ***Final Problem Set***

In addition to the weekly assignments, participants will be required to complete a final problem set and receive a non-failing score (7/10 pts). This problem set will integrate material from across the course and be provided as an R Markdown file. The final week of the course will be devoted to this work.

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## **PARTICIPANT AND INSTRUCTOR EXPECTATIONS**

### ***Time Expectations***

Depending on previous experience with R, participants should expect to spend 4-8 hours per week on instructional videos, analysis demonstration code scripts, interacting on discussion boards, and virtual meetings. Completion of readings and problem sets are not included in this estimate but are expected to take an additional 8-10 hours per week.

### ***Computing Requirements***

Participants will be required to conduct all analyses in Program R using RStudio – both programs are free and open source. Participants are expected to install these programs on their personal computers.

### ***Individual Work***

Collaboration (through the discussion board on Blackboard or by other means) is encouraged and will be highly beneficial in completing the problem sets. However, each participant is expected to produce their own code and assignment submission. When posting to the discussion board, keep this in mind: providing support or answering a question is different from providing the answer to a problem. *Posts deemed to provide too much information will be removed.*

### ***Communication***

Announcements and reminders posted on Blackboard will be the primary form of communication for material relevant to the whole class. *For personal communication, email is the best means to reach us.* Emails received during the work week will be returned within 24-48 hours. Emails received over the weekend may not be returned until the following Monday.

### ***Assignment Expectations and Submission***

*All analyses are to be conducted using the R computing environment.*

#### **R markdown assignments**

There will be seven weekly assignments and a final problem set in which you will answer a series of questions in an R Markdown document. To receive a certificate, you may choose to do three or more of the seven weekly assignments and must complete the final problem set. Each week will include at least one well-commented

and detailed demonstration scripts and/or R Markdown files that teach the relevant approach and appropriate code. Participants are encouraged to reference these scripts to understand syntax and format of the functions required for their analyses. The points allotted to each question will be provided to you in the R Markdown document itself. In addition to per-question point values, improper code formatting and use of functions outside of those provided will represent a significant reduction in allotted points.

### ***Late Policy***

As noted above, assignments submitted after the due date will not be accepted.

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## **UNIVERSITY POLICIES**

### ***Academic Integrity***

The integrity of the University community is affected by the individual choices made by each of us. Mason has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow at all times are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow participants, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct. Plagiarism means using the exact words, opinions, or factual information from another person without giving the person credit. Writers give credit through accepted documentation styles, such as parenthetical citation, footnotes, or endnotes. Paraphrased material must also be cited, using MLA or APA format. A simple listing of books or articles is not sufficient. Plagiarism is the equivalent of intellectual robbery and cannot be tolerated in the academic setting. If you have any doubts about what constitutes plagiarism, please see me.

### ***Disability Accommodations***

If you are a participant with a disability and you need academic accommodations, please see me and contact Disability Services at 703-993-2474, <http://ds.gmu.edu>. All academic accommodations must be arranged through Disability Services.

### ***Sexual Harassment, Sexual Misconduct, and Interpersonal Violence***

George Mason University is committed to providing a learning, living and working environment that is free from discrimination and a campus that is free of sexual misconduct and other acts of interpersonal violence in order to promote community well-being and participant success. We encourage participants who believe that they have been sexually harassed, assaulted or subjected to sexual misconduct to seek assistance and support. University Policy 1202: Sexual Harassment and Misconduct speaks to the specifics of Mason's process, the resources, and the options available to participants.

*Notice of mandatory reporting of sexual assault, interpersonal violence, and stalking:* As a faculty member, I am designated as a "Responsible Employee," and must report all disclosures of sexual assault, interpersonal violence, and stalking to Mason's Title IX Coordinator per University Policy 1412. You may seek assistance from Mason's Title IX Coordinator, Jennifer Hammat, by calling 703-993-8730 or email [cde@gmu.edu](mailto:cde@gmu.edu). If you wish to speak with someone confidentially, please contact one of Mason's confidential resources, such as Student Support and Advocacy Center (SSAC) at 703-993-3686 or Counseling and Psychology Services (CAPS) at 703-993-2380. The 24-hour Sexual and Intimate Partner Violence Crisis Line for Mason is 703-380-1434.

### ***Privacy***

To preserve student privacy, students must use their MasonLive email account to receive important University information, including communications related to this class. I will not respond to messages sent from or send messages to a non-Mason email address. Also, I will not share or reveal, and students must not share or reveal, student email addresses with others inside or outside this class without students' express permission.