

Course Syllabus

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R Programming Spring 2025 weeks 11-15

Instructor Vic Kelson, vkelson@indiana.edu

Prerequisites

A desire to enhance your use of computing systems

Textbook

R for Everyone (Advanced Analytics and Graphics) by Jared Lander. This is available from many sellers, including in the Amazon Kindle format. I have the Kindle version, which is much cheaper and very convenient. [Visit the author's website for more information](#)[Links to an external site.](#).

Software

We will be utilizing R version 4. All of our course sessions will utilize Jupyter Lab notebooks, as we did with Python.

Learning Outcomes

- Ability to write analysis scripts in the R language to facilitate data analysis and enhance research productivity *Proficiency in the use of Jupyter Notebooks as a vehicle for learning and collaboration
- Intermediate R programming skills
- Retrieving data from the worldwide web
- Using data frames for data processing and cleanup
- Advanced plotting
- Regression and other modeling tool

Office Hours

I will be holding Office Hours via Zoom this semester. There will be one session each week. Additional office hours may be arranged by appointment, either for single students or groups.

- Monday 7:00 PM - 8:30 PM

Course Assignments

In a five-week course, it's not really possible to do a traditional "final examination", and besides, this course is intended to help you develop a practical skill. So all of the grading is based on the homework exercises and one short presentation.

Exercises (0%):

After each of the odd-numbered class sessions, you will be given an exercise to solve on your own time. I will discuss my solution on the Thursday following. The purpose of the exercises is to give you chances to be coding without grade pressure. I'll try to make the exercises fun!

Homework assignments (75%):

Since the goal of the course is to encourage students to include programming and scripting in their daily work, a Homework Assignment will be given after each of the first four even-numbered class sessions. Each assignment will be in the form of a Jupyter workbook, and the workbooks will be submitted via Canvas. Each assignment will be worth 20 points, and will be due on the Tuesday following the assignment. We will discuss my solution to the problem in class on Tuesday.

Making coding part of your personal work flow (25%)

One of the highlights at Pycon, the international Python community conference, are sessions of “lightning talks”. Lightning talks are three-minute presentations, many spontaneously developed during the conference.

Since Each student is expected to seek opportunities to use programming in their personal work or research, our last class session will be a Lightning Talk session devoted to student presentations of a way they've used programming during the semester that was unrelated to the programming course. This can be a topic related to other coursework, research, or just a fun outside activity, and can be a Python application or other programming activity. You'll have three minutes to tell your story! Your lightning talk will be worth 20 points.

Schedule

As I was writing this, I noticed that the published and amended schedule has 11 days scheduled for this five-week course, and it is usually 10 days. As a result, I'm writing this in terms of the session-number sequence. I'll update to put the calendar in when I know more.

Session 1 Mar 25, 2024 - Introducing R

- Variable naming
- Scalar data types
- Vector data
 - Vector math

- Vector indexing

Session 2, Mar 27 2024 - More advanced structured data types

- Missing values and NULL values
- Factors
- Matrices
- Introducing R data frames

Session 3 Apr 1, 2024 - Sorting data and one more container type

- Sorting
- Lists

Session 4 Apr 3, 2024 - Procedural programming in R

- A *functional* language, not an object-oriented one
- Writing functions
- Conditional structures
- Looping structures

Session 5 Apr 10, 2024- Vectorized computation

- Avoiding loops by utilizing vectorized calculations
- Functions that support vectorization
- Aggregation

Session 6 Apr 15, 2024 - Making statistical plots

- Built-in plots
- Using the **ggplot2** library

Session 7 Apr 17, 2024 - String processing

- General-purpose string processing techniques
- Regular expressions
- Integrating Python and R

Session 8 Apr 22, 2024- Data shaping with R

- Reshaping data frames
- Making tidy data sets
- Pivoting and pivot tables

Session 9 Apr 24, 2022 - Lightning Talks

- Student Lightning Talks about personal applications

About the instructor

I am a 1998 SPEA Ph.D. graduate, having studied under Dr. Henk Haitjema. I also hold a B.S. in Chemical and Petroleum-Refining Engineering from Colorado School of Mines. Prior to graduate school, I worked as a process and process-control engineer in the chemical and plastics industries. As part of that work, I developed simulation tools as part of process-improvement projects

After graduate school, I worked for two years at the South Florida Water Management District as a Senior Engineer in the Hydrologic Systems Modeling department. I returned to Bloomington as Chief Modeler for WHPA Inc., a water-supply planning consulting company. In 2008 we sold WHPA to Layne Christensen Company, the largest water-well drilling firm in the US. Our Layne Hydro team conducted numerous water-supply studies, and were awarded the 2015 National Groundwater Supply Project Award by the National Groundwater Association. In April 2016, I left Layne to become the City of Bloomington Utilities Director. CBU is responsible for water supply, wastewater treatment and storm water management in the city of Bloomington. I now serve as Executive Director of the Evansville Water and Sewer Utility.

I am the author of several software products, including the U.S. EPA code WhAEM for Windows, GFLOW, and the open-source AEM code ModAEM. Since 1998, I have done quite a lot of computer programming for hydrological analysis in the Python language, and have taught dozens of scientists and engineers to use Python in their daily work.

Civility:

Pursuant to the Indiana University Student Code of Conduct, disorderly conduct which interferes with teaching or other university activities will not be tolerated and will be immediately reported to the Office of The Dean of Students for appropriate disposition which may result in disciplinary action including possible suspension and/or expulsion from the university. (Source: SPEA Academic Policies) O'Neill School expectations of civility and professional conduct:

The O'Neill School takes matters of honesty and integrity seriously because O'Neill is the training ground for future leaders in government, civic organizations, health organizations, and other institutions charged with providing resources for the public, and for members of society who are vulnerable and who are lacking in power and status.

Precisely because O'Neill graduates tend to rise to positions of power and responsibility, it is critical that the lessons of honesty and integrity are learned early. O'Neill requires that all members of its community – students, faculty, and staff – treat others with an attitude of mutual respect both in the classroom and during all academic and

nonacademic activities outside the classroom. A student is expected to show respect through behavior that promotes conditions in which all students can learn without interruption or distraction. These behaviors foster an appropriate atmosphere inside and outside the classroom

- Students are expected to attend class regularly and to be prepared for class.
- Students must be punctual in their arrival to class and be present and attentive for the duration of the class. Eating, sleeping, reading the newspaper, doing work for another class, wandering in and out of the classroom, and packing up or leaving class early are not civil or professional behaviors.
- Students must abide by the course policy regarding use of electronic devices in the classroom.
- Students must responsibly participate in class activities and during team meetings.
- Students must address faculty members, other students, and others appropriately and with respect whether in person, in writing, or in electronic communications.
- Students must show tolerance and respect for diverse nationalities, religions, races, sexual orientations, and physical abilities.
- Students must not destroy or deface classroom property nor leave litter in the classroom.

Copyright for Class Materials:

Unless otherwise noted, Professor Kelson holds the copyright to all materials posted on Canvas including videos. These materials may not be shared with anyone outside the class for which they are provided or be posted to another website without express written permission from the instructor. Any unauthorized use, copying, or distribution of class materials may result in disciplinary action and may also lead to civil or criminal penalties.

Note Selling:

Several commercial services have approached students regarding selling class notes/study guides to their classmates. Selling the instructor's notes/study guides in this course is not permitted. Violations of this policy will be reported to the Dean of Students as academic misconduct (violation of course rules). Sanctions for These expectations are excerpted from the O'Neill School Honor Code which can be found at:

<https://students.oneill.indiana.edu/doc/ugrad-doc/ugrd-student-honor-code.pdf>Links to an external site.

Academic misconduct may include a failing grade on the assignment for which the notes/study guides are being sold, a reduction in your final course grade, or a failing grade in the course, among other possibilities. Additionally, you should know that selling a faculty member's notes/study guides individually or on behalf of one of these services using IU email, or via Canvas may also constitute a violation of IU information technology and IU intellectual property policies; additional consequences may result.

Online Course Materials

The faculty member teaching this course holds the exclusive right to distribute, modify, post, and reproduce course materials, including all written materials, study guides, lectures, assignments, exercises, and exams. While you are permitted to take notes on the online materials and lectures posted for this course for your personal use, you are not permitted to re-post in another forum, distribute, or reproduce content from this course without the express written permission of the faculty member. Any violation of this course rule will be reported to the appropriate university offices and officials, including to the Dean of Students as academic misconduct.

Canvas notifications:

Students control their own Canvas notifications. Since I set up Canvas assignments on a weekly basis, you may receive a notification each time I post or revise an assignment. To reduce the number of notifications, adjust your Canvas settings. Consider using Boost to set up reminders.

Plagiarism and Academic Dishonesty:

SPEA faculty do not tolerate cheating, plagiarism, or any other form of academic misconduct. Please read the Indiana University student code of ethics at <http://www.iu.edu/~codeLinks to an external site.> so that you will be sure to understand what these terms mean and what penalties can be issued for academic dishonesty. Academic dishonesty can result in a grade of F for the class, and an F for academic dishonesty cannot be removed from your transcript. Faculty members are required to report academic dishonesty to the Dean of Students and disciplinary action can be taken by the Dean. Significant violations of the Code can result in expulsion from the university. Academic dishonesty includes cheating in any form on the team project, homework and quizzes, tests, and the final exam.

Incompletes:

The grade of Incomplete used on the final grade reports indicates that the work is satisfactory as of the end of the semester but has not been completed. The grade of

Incomplete may be given only when the completed portion of a student's work in the course is of passing quality. Instructors may award the grade of Incomplete upon a showing of such hardship to a student as would render it unjust to hold the student to the time limits previously fixed for the completion of his/her work.

(<http://policies.iu.edu/policies/categories/academic-faculty-students/academicstudent-affairs/incompletes.shtml>Links to an external site.) In this course, Incompletes will be considered only with documentation of serious extenuating circumstances. If an Incomplete grade is recorded, the student must agree in writing to complete missing work according to a written schedule provided by the instructor. Per IU policy, Incompletes revert to an F if not corrected within one year.

Late Withdrawal:

Withdrawal after the automatic withdrawal period requires approval by the instructor and SPEA's Director of Undergraduate Studies and must be based on dire circumstances relating to extended illness or equivalent distress (IU Enrollment and Student Academic Information Bulletin). Requests to drop due to a failing grade will not be approved. You must be passing the course at the time of withdrawal. Contact your advisor. Boost: Students in this class are invited to use Boost, a free smartphone app developed at IU that provides notifications and reminders about schoolwork in Canvas. It is designed to help students keep track of assignment deadlines, important announcements, and course events all in one easy to-use app. For more information, see <https://kb.iu.edu/d/atud>Links to an external site. or <https://boost.iu.edu>Links to an external site..

Counseling and Psychological Services

For information about services offered to students by CAPS:

<http://healthcenter.indiana.edu/counseling/index.shtml>Links to an external site..

Religious Observation In accordance with the Office of the Dean of Faculties, any student who wishes to receive an excused absence from class must submit a request form available from the Dean of Faculties for each day to be absent. This form must be presented to the course instructor by the end of the second week of this semester. A separate form must be submitted for each day. The instructor will fill in the bottom section of the form and then return the original to the student. Information about the policy on religious observation can be found at the following website:

<https://policies.iu.edu/policies/aca-59-accommodation-religious-observances/index.html>Links to an external site..

Disability Services for Students

Securing accommodations for a student with disabilities is a responsibility shared by the student, the instructor and the DSS Office. For information about support services or accommodations available to students with disabilities, and for the procedures to be followed by students and instructors: <https://studentaffairs.indiana.edu/student-support/disability-services/index.html>Links to an external site..

Sexual Harassment

As your instructor, one of my responsibilities is to help create a safe learning environment on our campus. Title IX and our own Sexual Misconduct policy prohibit sexual misconduct. If you have experienced sexual misconduct, or know someone who has, the University can help. If you are seeking help and would like to talk to someone confidentially, you can make an appointment with:

1. The Sexual Assault Crisis Service (SACS) at 812-855-8900
2. Counseling and Psychological Services (CAPS) at 812-855-5711
3. Confidential Victim Advocates (CVA) at 812-856-2469
4. IU Health Center at 812-855-4011 For more information about available resources: <http://stopsexualviolence.iu.edu/help/index.html>Links to an external site.. It is also important to know that federal regulations and University policy require me to promptly convey any information about potential sexual misconduct known to me to our campus' Deputy Title IX Coordinator or IU's Title IX Coordinator. In that event, they will work with a small number of others on campus to ensure that appropriate measures are taken and resources are made available to the student who may have been harmed. Protecting a student's privacy is of utmost concern, and all involved will only share information with those that need to know to ensure the University can respond and assist. I encourage you to visit <http://stopsexualviolence.iu.edu/help/index.html>Links to an external site. to learn more.

Commitment to Diversity: Find your home and community at IU

Asian Culture Center

Address: 807 East Tenth Street, Bloomington, IN 47408 Phone: 812-856-5361 Email: acc@indiana.edu Website: <https://asianresource.indiana.edu/index.html>Links to an external site.

First Nations Educational & Cultural Center

Address: 712 E 8th St., Bloomington, IN 47408 Phone: 812-855-4814 Email: fnecc@indiana.edu Website: <https://firstnations.indiana.edu/contact/index.html> Links to an external site.

LGBTQ+ Culture Center

Address: 705 E 7th St., Bloomington, Indiana 47408 Phone: 812-855-4252 Email: glbtserve@indiana.edu Website: <https://lgbtq.indiana.edu/contact/index.html> Links to an external site.

La Casa Latino Culture Center

Address: 715 E 7th St., Bloomington IN, 47408 Phone: 812-855-0174 Email: lacasa@indiana.edu Website: <https://lacasa.indiana.edu/> Links to an external site.

Neal Marshall Black Culture Center

Address: 275 N Jordan Ave Bloomington, Indiana 47405 Phone: 812-855-9271 Email: nmgrad@indiana.edu Website: <https://blackculture.indiana.edu/index.html>