QSS 19: Advanced Data Visualization

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Dartmouth College, Spring 2023

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Office Hours: TBD

Office: 121A & Virtual via Zoom

Class Hours: 2A (2:25 - 4:15 T/Th)

Classroom: TBD

Course Description

Data visualization allows data analysts to present findings to the broader public. The QSS 19 advanced data visualization course maximizes students' abilities to communicate social science research through advanced graphical representations, including many of the more advanced forms of visualization suitable for the web or other forms of publication. Javascript, HTML widgets, dashboards, and animated plots designed for social media and the web will be covered at length. Students will execute projects building their own web-based dashboards and visualizations designed to communicate patterns in data from the results of real-world research. As an extension of QSS 17, we will continue to learn principles of good visualization and the tenets of color theory, applying these principles to our mapping of data to plots, with an aim to share and frame our data analyses persuasively and without bias.

Course Objectives and Outcomes

1. Students will advance their fluency in **R**, in *ggplot2*, and in the many geometric visualizations available, including varieties of Cartesian coordinate plots, polar coordinate plots, maps, animations, and more.

2. Students will advance their knowledge of functional and iterative programming in order to facilitate better wrangling and visualization.

3. Students will learn to use Javascript and its many visualization libraries to produce advanced HTML-based visualizations that integrate with **R**.

4. Students will learn how **R** works with other tools, applications and packages (Plotly and Shiny) to present highly professional, interactive visualizations.

5. Students will learn to write professional projects, papers, and other with embedded **R** code and graphics in Markdown.

6. Students will advance their abilities to gather data via web scraping and a basic introduction to interacting with APIs.

Required Readings

There are two required texts for this course. Additional readings may be assigned on a week-by-week basis.

- Coene, John. *Javascript for R.* 2021. Sebastopol, CA: O'Reilly.

    - This book can be found free online at: <https://book.javascript-for-r.com>

- Wickham, Hadley.*ggplot2: Elegant Graphics for Data Analysis*. 2nd ed. Houston: Springer.

    - This book can be found free online at: <https://ggplot2-book.org/index.html>

Readings and Video Viewings

Required readings from assigned texts will be interspersed throughout the quarter. In addition, the instructor will be sharing some videos tailored to the set of skills most useful to completing assignments, as well as to broader research endeavors. Matching or approximately matching slides will attend the videos. These videos and slides will be made available through Canvas links.

Course Policy

While I intend to execute class as a more traditional, live course, we need to maintain the ability to flexible and adapt to potentially rapidly changing circumstances. The course adopts a "resilient learning" approach, mixing synchronous and asynchronous elements as needs require. In-class sessions will be accompanied by occasional videos created by the instructor. Documents and videos related to live teaching sessions will be available in Canvas files for those who could not attend. Zoom virtual meetings will supplement classroom and office hours time. If any of you have difficulties with your computer, a virtual machine has been set up for QSS students to run RStudio. In addition, RStudio has an RStudio Cloud environment available for your use. Weekly assignments will allow you to practice the topics covered by live lectures and both sets of videos. Two projects during the quarter will require that you engage real social science data, creating your own visualizations designed to best emphasize the stories told by the data. The final project will involve the creation of a web-based dashboard or platform presenting interactive and animated visualizations based on real-world data relevant to social science research. A final project session will allow students to present their final projects to fellow students an an interactive environment.

Attendance

You are expected to attend class in person unless you have made alternative arrangements due to illness, medical reasons, or the need to isolate due to COVID-19. For the health and safety of our class community, please: do not attend class when you are sick, nor when you have been instructed by Student Health Services to stay home. You will be able to view recordings of class in Canvas if you are unable to attend.

Student Accessibility and Accommodations

Students requesting disability-related accommodations and services for this course are required to register with Student Accessibility Services (SAS; Getting Started with SAS webpage; student.accessibility.services@dartmouth.edu; 1-603-646-9900) and to request that an accommodation email be sent to me in advance of the need for an accommodation. Then, students should schedule a follow-up meeting with me to determine relevant details such as what role SAS or its Testing Center may play in accommodation implementation. This process works best for everyone when completed as early in the quarter as possible. If students have questions about whether they are eligible for accommodations or have concerns about the implementation of their accommodations, they should contact the SAS office. All inquiries and discussions will remain confidential.

Grading Policy

Final grades will be administered on a typical Dartmouth scale. Nonetheless, I will be mindful of the special circumstances of the pandemic. Weekly assignments represent the largest chunk of your grade. Two mid-course projects and one final project allow students to demonstrate their developing mastery of the material in QSS 19. Students experiencing difficulties finishing assignments are encouraged to reach out to me as soon as possible.

- **40%** of your underlying grade will be determined by weekly exercises due on following Mondays. One of these assignments will be dropped.

- **25%** of your underlying grade will be determined by two projects engaging real social science data, at least one of which will be timed.

- **25%** of your underlying grade will be determined by a final project, in which you create a Javascript-R or Shiny-based visualization with interactive and animated components.

- **10%** of your underlying grade will be determined by participation in class and on class Slack channels.

Mental health

The academic environment at Dartmouth is challenging, terms are intensive, and the COVID-19 pandemic has not made things easier. There are a number of resources available to you, on campus and remote, to support student wellness. Please follow the links below to the resources available.

Office of the Undergraduate Dean (https://students.dartmouth.edu/undergraduate-deans/)
Counseling and Human Development (http://www.dartmouth.edu/~chd/)
Student Wellness Center (https://students.dartmouth.edu/wellness-center/)

Academic Dishonesty Policy

Students are responsible for understanding the academic integrity rules at Dartmouth. Explanations of integrity rules and principles can be found at http://www.dartmouth.edu/~uja/. Ignorance of the Academic Honor Principle will not be considered an excuse if a violation occurs. Beyond any penalties imposed as a consequence of an Academic Honor Principle investigation, any student who is found to have cheated or plagiarized on any assignment will receive a failing grade in the

class. Details on citing sources are available at http://www.dartmouth.edu/~writing/sources. Please see me immediately if you have any questions or concerns.

Religious Observances

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in the course, please virtually meet with me before the end of the second week of the term to discuss appropriate accommodations.

Schedule

Week 1, 03/27 - 03/31: Review of **R**, Objects, Data, Basic Plotting and Principles

- Objects and classes, coercion, basic functions, geometric plots
- Readings: Wickham Chs 1-6, 8-9

Week 2, 04/03 - 04/07: Visualization Principles and Color Theory Review)

- Accessibility and color palettes, color properties, and principles of good visualization.
- Readings: Cleveland and McGill 1984; Wickham Chs. 10-18

Week 3, 04/10 - 04/14: Functions and their Applications

- Functional programming, iterative programming, and regularizing data work from lists.
- Customization tricks revisited.
- Readings: Wickham Chs. 19-22

Week 4, 04/17 - 04/21: Introduction to Javascript, JSON data, and HTML for visualization

- An introduction to the JSON data format and the `jsonlite` package
- Readings: Coene, Chs. 1-2
- **Project 1 Due**

Week 5, 04/24 - 04/28: Introduction to Widgets for Visualization

- Plotly, Crosstalk, and the DT package
- Integrating Javascript libraries with R: Plotly.js, highchart.js, chart.js
- Scaffolding and Implementation
- Readings: Coene Chs. 3-5

Week 6, 05/01 - 05/05: More Javascript visualization libraries to integrate with R

- An introduction to D3.js, Reveal.js, and Remark.js
- Readings: Coene Chs. 6-7

Week 7, 05/08 - 05/12: Advanced Visualization Topics: Adaptive Visualizations

- Shared variables, Resizing, Pre-rendering Hooks, Security
- Readings: Coene Chs. 8-10
- **Project 2 Due**

Week 8, 05/15 - 05/19: Advanced Topics: Prepending and Appending Content

- Prepending and Appending content, Unit tests, Good performance

Week 9, 05/22 - 05/26: Putting It All Together: Customizing HTML and Shiny Widgets

- Websocket and Shiny
- Readings: Coene Chs. 11-12

Week 10, 05/29 - 06/02: Wrapping Up

- Flex topics and Finals Week
- **Final Project Due**