CDS 301 / CDS 501 Syllabus Scientific Information and Data Visualization

Spring 2021

Course General Description

This course is an in-depth study of the methods and software used in Data Science to visualize complex information. Topics include data visualization, interactive visual analytics, storytelling with data and the effective communication of information. Elements of usability, user experience, and the psychology of the user are developed. Exercises to help students develop their understanding of the role that visualization plays in computational science are completed. Provides a foundation for data visualization applications in their careers. Students complete a data-driven group project.

Data visualization is a subfield of data science that has the intrinsic purpose of communicating the results of data analyses in a coherent, integrated way, through maps, charts, graphs and other visual elements. Particularly for the social and behavioral sciences, data visualization is useful in understanding large datasets, noisy datasets or emphasizing connections between various elements or phenomena that are not immediately obvious to social scientists.

MASON Social and Behavioral Sciences CORE Course Description

This course addresses the following requirements for Social and Behavioral Sciences:

1. Explain how individuals, groups or institutions are influenced by contextual factors
2. Demonstrate awareness of changes in social and cultural constructs
3. Use appropriate methods and resources to apply social and behavioral science concepts, terminology, principles and theories in the analysis of significant human issues, past or present.

These requirements are addressed by the course in the following ways:

1. Students will use R and learn how to create comprehensive visualizations, based on the best visualization concepts and principles currently used in statistics, computational modeling and in practice. Additionally, they will learn how to apply these visualization techniques to social phenomena specific data and how to communicate various aspects of social phenomena graphically, such as the use of energy worldwide, the economic growth based on geographic specific or policy specific data, or changes and evolutions of phenomena in time. While social sciences have relied on graphs and visualizations for a long time, such as pie charts or histograms or line graphs, enhancing basic plotting or

graphic techniques in a dynamic fashion or creating better informational maps has not been easily accessible before data science became a practice.

2. In this course, we will explore various visualization techniques of various data sets and case studies from social sciences, such as alternative energy industries growth and comparisons, student behavior on campus, communication networks, the evolution of world languages, maritime and air flows, historical data of social complexity spread, and many more. We will show which data visualizations are more appropriate to emphasize one aspect or one analysis over another, both within the same dataset/phenomenon and across various datasets/phenomena, that are related to each other.

3. We will also teach visualizations of synthetic, simulated data from social behavior models, such as cooperation vs. competition models, epidemic spread models, consumption adoption and also from social science theories such as ingroup-outgroup theory, market price mechanisms, a.s.o. We will also be teaching dynamic and interactive data visualizations, through the use of packages such as Shiny and/or Plotly, which will enable students to create industry-level quality presentations. Students will also learn how to use satellite imagery data to analyze changes in social phenomena and policy from in time or space, that is not otherwise available to collect through standardized data collection efforts.
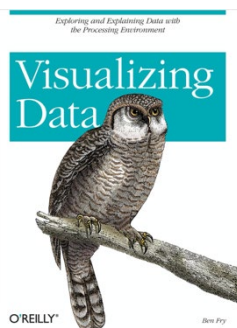
• Prerequisites: CDS-101 or CDS-130, or equivalent, or permission of the instructor

Instructor, Course Hours and Office Hours

- Instructor: https://science.gmu.edu/directory/anamaria-berea
- TA: Carmen Iasiello

Textbook

The following textbook is required and is available for free through the library.

• Title: Visualizing Data

• Author: Ben Fry
• Publisher: O'Reilly Media Inc.
• Edition: First Edition

There will also be several selected reading assignments throughout the semester that will be provided as we go.

Computing Environment

Visualizations will be developed using a variety of tools. You are encouraged to actively follow along with the posted code scripts. Python and R, with packages such as Plotly and Shiny will be used to a significant extent throughout the semester. 3D/scientific data visualization tools will also be demonstrated.

Blackboard

Blackboard will be used for all official homework and term project submissions.

Course Policies

Contact Policy

Please allow up approximately 24 hours for an e-mail response during weekdays. I check and respond to messages less frequently over weekends and school holidays. For longer questions, I will ask you to come to arrange a time to meet with me or the teaching assistant.

Attendance Policy

This class is asynchronous.

Illness and Emergencies

It is a student's responsibility to inform me about illnesses or personal/family emergencies that will interfere with your ability to complete assignments. This must be done as soon as possible. All students are expected to exercise personal responsibility. It is not acceptable to wait to tell me about the impacts of a personal illness or emergency until you're about to fail the course due to missing deadlines.

Late Work Policy

In general, failing to submit an assignment on time will result in a zero. Extensions may be granted in the case of illness or a family emergency at my discretion (see Illness and emergencies section), and it is the student's responsibility to inform me about these kinds of circumstances as soon as possible.

Accommodations Policy

Students with disabilities who need academic accommodations, please see me and contact the Office of Disability Services (ODS) at (703) 993-2474. All academic accommodations must be arranged through the ODS: http://ods.gmu.edu/.

Grading and Course Requirements - CDS-301

• Homework - 35%
• Term Project - 35%
• Final - 30%

CDS-501 students will have an additional requirement involving an in class presentation of a special topic which we will discuss in class.

Grading and Course Requirements - CDS-501

• Homework - 25%
• Special Topic Presentation - 10%
• Term Project - 35%
• Final - 30%

Grading Schema - Based on the final total score, your final grade will be determined as follows:

A+ [97-100], A [93-96], A- [90-92], B+ [87-89], B [83-86], B- [80-82], C [70-79], D [60-69], F [<60].

Expectations

Homework

There will be 10 homework assignments assigned during the semester. Homeworks will be due one week after they are assigned.

Term Project

The term project will be discussed in detail and is described in its own document.

Final

The final exam will be a take-home exam and will cover material covered throughout the semester.

Schedule (Note: Schedule subject to change.)

CDS 301/501 Schedule

Week	Topic	What is Due
1	Introduction to data visualization for social and behavioral sciences	
2	Tufte's principles of visualization applied to social sciences	HW1
3	Communicating data analyses results - principles of effective communication with graphs, plots, images and maps	HW2
4	Plotly for embedded visualizations	HW2
5	Shiny for interactive visualizations	HW3
6	GGplot introductions	HW4
7	GIS visualizations	HW5
8	3D plots and visualizations	HW6
9	Intro to image processing	HW7
10	Visualizing sound data	HW8
11	Visualizing language and text mining data	HW9
12	Visualizing networks; igraph and network packages	HW10
13	Summary of Semester	Class Project
14	Student Presentations	
May 3	**Final Exam**	

Conduct

Academic Integrity

The George Mason Academic Honor Code can be reviewed at https://oai.gmu.edu/mason-honor-code/.

Homeworks and exams should be completed by each student individually unless explicitly stated otherwise. Homework solutions should not be shared between students. Communication regarding data sources, software installation issues and basic usage problems may be shared. Material of any kind, that is taken in whole or in part from another source should be properly cited in your homework or term project.

Decorum/Discourse

Students are expected to be civil in their classroom conduct and respectful of their fellow classmates and the instructor for the duration of the course. Examples of expected behavior include, but are not limited to, not interrupting your classmates or the instructor, refraining from using devices for anything other than coursework, and coming to class prepared with questions for discussion. These expectations remain in effect for all online discussions.

I will address violations of classroom decorum on a case-by-case basis and reserve the right to enact grade-based penalties for highly disruptive or repeat violations. Penalties for decorum violations cannot be negotiated or appealed.

Mason Diversity Statement

George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals. Diversity is broadly defined to include such characteristics as, but not limited to, race, ethnicity, gender, religion, age, disability, and sexual orientation. Diversity also entails different viewpoints, philosophies, and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds and practices have the opportunity to be voiced, heard and respected.

Support Services

George Mason provides Counseling and Psychological Services (CAPS) for students. Contact them at (703) 993-2380 or http://caps.gmu.edu/.

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 1202. 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 703-380-1434 or Counseling and Psychological Services (CAPS) at 703-993-2380. You may also seek assistance from Mason's Title IX Coordinator by calling 703-993-8730 or emailing titleix@gmu.edu.

Disclaimer

The instructor reserves the right to modify this syllabus at any time during the course to improve the learning experience and classroom environment. The pacing of the course and the list of covered topics may also be altered in response to student progress. The course objectives reflect what a student is expected to understand by the end of the course after putting in the necessary time and effort both inside and outside the classroom and completing all assignments. These outcomes are not a guarantee, and students will get more out of the course the more they put into it. Any acquired skills and knowledge can fade over time if not reviewed or practiced after the course concludes.