Naumova, Elena N.

Short Course Description:

This course provides students with tools and techniques to analyze and critique current forms of data visualizations in both public media and research literature. We instruct students on how to create high quality graphical displays with a keen understanding of the challenges of presenting complex information to various audiences. Using research data, students build a portfolio of graphical displays and descriptions intended for both scientific journals and popular media. This course also emphasizes effective data communication, including clear, comprehensive, and effective descriptions of graphical displays for various scientific and general audiences. This course was part of an NSF-funded study and incorporates essential components of the SOLSTICE teaching approach.

Syllabus

Tufts University, Friedman School of Nutrition Science and Policy

NUTR 393: Data Visualization and Effective Communication

Spring 2024

Class Meetings*:	*Mondays, 3:00 – 5:00pm EST*
(Mandatory)	*Attending in Person:* Friedman School, Jaharis Center, Room 105
	Attending Online: Recurring Meeting Zoom Link
Practicum*:	*Wednesdays, 2:00 - 3:00pm EST*
(Mandatory)	*Online Only:* Recurring Meeting Zoom Link
Office Hours:	*Wednesdays, 3:00 - 4:00pm EST*
(Optional)	*Online Only:* Recurring Meeting Zoom Link

* Please note that Zoom links have been scheduled to begin 15 minutes before and end 15 minutes after scheduled times. Please log onto the Zoom link at least 5 minutes before the scheduled times above.

Instructors:	*Elena N. Naumova, PhD, Professor (Elena.Naumova@tufts.edu)*
Practicum Co-Instructor*:	*Corby Kummer, Senior Lecturer (Corby.Kummer@tufts.edu)*
Teaching Assistants*:	*Yutong Chen, PhD Candidate (Yutong.Chen@tufts.edu)*
	Bingjie Zhou, MS, Data Scientist (Bingjie.Zhou@tufts.edu)

* When contacting the teaching team, please direct your emails to all instructors and teaching assistants so that we may assist you as quickly and accurately as possible.

Acknowledgment of Support:

This course development and implementation would not be possible without the guidance and support of many professionals. Their help is instrumental in designing and providing educational material and resources including but not limited by creating personalized websites for Student Portfolios, selecting and curation educational datasets and tutorials, advising on crafting assessment tools, building Canvas sites, and providing the visual and audio support. Special thanks to:

- Kyle M. Monahan, Manager, Data Science Services, TTS
- David Grogan, Senior Solutions Specialist Educational Technology Services, TTS

Justification:

Nutrition and health research rely more on data visualization and effective communication to understand, explain, and predict key outcomes and processes. The existing and emerging information tools provide researchers and practitioners with valuable assistance, yet failure to use these tools effectively and in a well-thought-out manner processes can lead to confusions, misunderstanding, misleading conclusions and concerns surrounding ethics and bias. This course is intended to keep our students informed and better prepared to enter the national workforce.

Graduate Credits: *3 Semester Hour Units (SHUs) – former 1 credit*

Prerequisites: There are no prerequisites needed for the class. The course has been designed to allow students to participate from diverse backgrounds. We encourage some working knowledge of data analytics and visualizations software and encourage the use of Excel, Stata, R, or Tableau.

Pre-Course Expectations: Students should attempt to identify datasets relevant to their specific interests prior to the course. The instructor(s) and teaching assistant(s) will approve dataset suitability. If students cannot identify appropriate datasets, please use our compiled resources at **Canvas > Files > Practicum**, which is also available in Module 0 on Canvas. Please also contact your research advisors about datasets they may suggest.

Description: This course provides students with tools and techniques to analyze and critique current forms of data visualizations in both public media and research literature. Students learn to construct high quality graphical displays with a keen understanding of the challenges of presenting complex information to various audiences. Students will build a portfolio of graphical displays and descriptions intended for both scientific journals and popular media. Research data will be typical for nutrition sciences and sufficient to conduct analyses using standard statistical software. Course assignments and feedback will train students to communicate their findings clearly and concisely. Emphasis will be placed on developing a conceptual understanding of data visualizations and building effective communications for describing these graphical displays.

Course Duration: This pilot semester-long course spanning 14 weeks, with a mix of lectures, student's portfolio posts, in-class activities, and student-led projects.

Course Objectives:

a. Outcomes Addressed by the Course:

- Understand the impact of data visualizations in public media and research literature on science, medicine, and public policy.
- Learn how to construct high-quality graphical displays with a keen understanding of the challenges of presenting complex information to various audiences.
- Learn to value teamwork and to be a good team player.
- Learn to value ethical aspects of data visualization and science communication.

b. Specific Outcomes of Instruction:

- Articulate and exemplify the basic rules of constructing data visuals, including evidence, efficiency, emphasis and ethics.
- Identify challenges and key details of data visualization techniques and analyze the quality of graphical presentations in the popular press and academic journals
- Articulate the perspectives, language, and terminology of methodological and statistical problems associated with a research question or hypothesis
- Integrate findings from other lines of research in interpreting and drawing inferences from evidence-based research to derive meaningful conclusions
- Integrate data and information from basic, clinical, environmental, social, and population sciences to prepare data for visualization
- Produce high-quality tables, graphs, and visuals using mainstream software

Accommodation of Disabilities: Tufts University is committed to providing equal access and support to all students through the provision of reasonable accommodations so that each student may access their curricula and achieve their personal and academic potential. If you have a disability that requires reasonable accommodations, please contact the Friedman School Assistant Dean of Student Affairs at 617-636-6719 to decide for

appropriate accommodations. Please be aware that accommodations cannot be enacted retroactively, making timeliness a critical aspect for their provision.

Diversity Statement: Students will have many opportunities to discuss ethical dimensions of data analytics and explore challenging issues. This course aims to increase understanding of different perspectives via structured and unstructured discussions and encourage students to provide constructive critical assessment and feedback on feedback. Such conversations may not always be easy and require trust, practice, patience, courage, and imagination. The ground rule for the class is to have due regard for the feelings, wishes, rights, or traditions of others and to respect each other's' backgrounds, experiences, and positions, as we deepen our understandings of multiple perspectives striving to acquire, develop, and communicate research findings to the best of our knowledge.

Academic Conduct: Each student is responsible for upholding the highest standards of academic integrity, as specified in the Friedman School's Policies and Procedures manual and Tufts University policies. It is the responsibility of each student to understand and comply with these standards, as violations will be sanctioned by penalties ranging from failure on an assignment and to dismissal from the school. When students are experiencing academic challenges or difficulties with coursework, we invite students to resolve them by speaking with Instructor during office hours and seeking support from assistants. Please note that each homework assignment contains a section to report on ongoing challenges, that we systematically review.

Professional Ethics: This course adopt the ethical guidelines of several professional organization: the American Statistical Association, the International Statistical Institute, The guidelines aim to promote accountability by informing those who rely on any aspects of statistical practice of the standards they should expect. We expect that students may encounter situations when it is essential to be aware of these guidelines. For example, in dealing with personal and confidential information, erroneous records, decisions based on personal or group judgment, intentional and non-intentional introduction of bias. All statistical practitioners are expected to follow these guidelines and encourage others to do the same. We also encourage students to learn about ethical guidelines of their professional organizations; for example, see The Code of Ethics for the Nutrition and Dietetics Profession. Society benefits from informed judgments supported by ethical practice.

AI Use Policy: In this course we apply the rules, specified by major publishers, such as: "Large Language Models (LLMs), do not currently satisfy our authorship criteria (Nature Portfolio, BMC, Springer) as an attribution of authorship, carries with it accountability for the work, which cannot be effectively applied to LLMs. Authors using LLMs in any way while developing a paper should document their use in the methods or acknowledgements sections, as appropriate." I support the use of AI-based tools, such as ChatGPT, Bing AI, and/or image generation tools, for purposes of initial draft development, spellchecking, and editing. Learning to use AI is an emerging skill, and we will be learning to use it properly together. I will be using ChatGPT to summarize your responses (see explanation below, as they are based on CELT recommendations and stemmed from my own experience).

Please be aware of the limits of these tools:

- Familiarize yourself with AI tools, don't trust anything that these AI models say. If it gives you a number or a fact, assume it is wrong unless you either know the answer or can check it with another source. You will be responsible for any errors or omissions provided by the tool. Using AI works best for topics you understand.
- AI is a tool, but one that you need to acknowledge using. Please include a paragraph at the end of any assignment where you used ChatGPT or any other form of AI explaining what you used it for, including the prompts. Failure to do so will be considered as a violation of academic integrity policy.

- Identify the way AI tools contributed to your work. Be thoughtful about when and how you use AI. If you provide minimum effort prompts, you will get low quality results. You will need to refine your prompts to get good outcomes.
- If you are using AI-tools to help inform your creative process in the context of this course, please document the use. This should include the version of the model, the last training data, and the access date (e.g. for ChatGPT: ChatGPT 3.5 August 3 Version, Accessed on August 14, 2023). Please note that these tools are constantly changing and evolving and our methods for citing them must adapt similarly.

Course Organization: This course will follow a hybrid design. Students are expected to participate in in-person sessions, watch asynchronous lectures, and complete all readings before class. Online discussion posts and reading reflections should be submitted on Canvas prior to class. Class time (offered in-person, Mondays) will be used for synchronous discussion of lecture materials, class activities, and instructor feedback on previously submitted assignments. Students are also mandated to attend a practicum session (offered virtually only, Wednesdays). Practicum sessions will include peer feedback on upcoming homework assignments and resource sharing for student's independent software programming learning. Office hours (offered virtually, Wednesdays or in-person by appointment only) are held after practicum sessions. At the end of each week (Fridays), students will be asked to complete written assignments and submit these on Canvas.

Course Time Requirements: The course is designed into a series of 12 modules, midterm, and final presentations. Each week students are expected to spend ~3 hours on synchronous instruction (discussions, practicum, peer feedback) and ~6 hours on asynchronous instruction (readings, lectures, discussion posts, assignments, data management, statistical coding, data analysis, peer feedback). Time requirements will differ by week and by student (estimates provided below).

Course Material	*Time per Week*	*Description*
In-Class Discussions	2 hours	In-class discussion sessions will be held every Monday. Students must attend in-person (and possibly virtually). These sessions are to: i) introduce and clarify new material, concepts, and key points of readings and lecture notes and respond to questions; ii) provide group feedback on student homework assignments; and iii) facilitate team-based exercises and activities; and guided discussion with guests.
Practicum Participation	1 hour	Practicums are mandatory and held virtually for all students. These sessions will take place on Wednesdays after Monday's in-class discussions and prior to written assignment submission on Friday's. As such, practicums will be used for reviewing student questions about upcoming homework assignments, peer-to-peer feedback, and small group discussions. Students can seek personalized instructions during Office Hours, which will take place virtually after the Practicum. Students will be divided into Zoom breakout rooms when needed.
Written Assignments	3 hours	Students will complete weekly written assignments by Friday of every week. Students will submit these assignments as Word document files on Canvas. Students will also post comments as plain text to allow for peer feedback. Weekly assignments are designed to build off one another and culminate in the completion of midterm and semester-long research projects.
Readings Assignments	1.5 hours	Students will be asked to complete 1-3 weekly readings and post a review about these readings on Canvas prior to arriving to Monday synchronous discussions.

Peer Feedback	0.5 hours	Students will be assigned partners based on similarities in project's subject area, datasets and analytical methods used. Students will submit various part of assignments on their websites and as plain text. Students are expected to provide peer comments on partners' assignments using prompted questions before class the following Monday.
Portfolio	0.5 hours	We designed web-based Student Portfolios to capture research project progress, offer means to provide feedback and demonstrate responsiveness to peers' and instructors' suggestions.
Away-From-Screen Time	0.5 hours	We have incorporated time for students to detach from online work. While not in front of a screen, students are expected to use this time to reflect on their research projects, course progress, and individual research goals. Your away-from-screen time should involve any form of favorite activity (walking, yoga, biking, etc.) away from the computer!
Asynchronous Material	(optional)	Lectures will be pre-recorded for independent viewing and posted on Canvas.

Work-Life Balance: We recognize that the workload and designed the course to ensure work-life balance. We encourage you to create a course schedule and set aside the required hours to complete the assignments. We recommend you monitoring time spent on individual assignments. We request to report time spent on readings, especially in the first part of the course. We ask to submit your assignments in reasonable hours (before 9m on Fridays) and ensure sufficient time for peers to comment. We also build the away-from-screen time.

Assessment and Grading: Please see the course grade assessment breakdown below.

Assessment	*Grade Value*	*Description*
Final Data Visualization Project	30%	Project topics should be unique and approved by the instructor(s). **The final report is expected to be a portfolio of graphical displays of research data.** Students will summarize their data analyses to create an infographic, structure-based, or processed-based visual. The visual will be supplemented with a detailed description of findings intended for a technical, scientific audience and for a general, public media audience. Visuals must be on a topic of the student's interests.
Midterm Presentation	30%	Parallel to the final presentation, students will complete a midterm presentation that **follows a similar structure as the final project.** Students will present one visualization that is a graph representation of univariate, bivariate, or multivariate data. Students are expected to provide structured critique to team group members.
Weekly Assignments	30%	**There will be 6 assignments given throughout the course. Assignments will typically consist of two parts.** Part 1 will require students to find, critique, or create a graphical representation. Part 2 will require students to revise and resubmit their visual and descriptions for both scientific and general audiences. Students will present and discuss works in class along with reading assingments.
Group Activities	10%	Students are expected to work in groups of three throughout the semester. During class, students will participate in activities as a **PI, Collaborator, and Reviewer** to provide self-assessment and peer-assessment of their course assignments.

A passing grade in the course is B- or better. Course grades will be based on the scheme below (subject to revision during the course):

A > 94% A- 90 - 94% B+ 87 - 90% B 84 - 87% B- 80 - 84% C < 84%

Assignment Submission Instructions: All homework assignments are posted on Friday one week before submission. The following policies will be strictly enforced on assignments.

*Submission Time**	*Points Possible*	*Description*
On-Time Written Assignment	90%	On-time submission is equivalent to 90% of available points. Additional 10% of points awarded for completion of Bonus Questions.
≤24 Hours Late	70%	Assignments received <24hrs after deadline will be penalized by a 20% grade reduction.
>25-48 Hours Late	50%	Assignments submitted 24-48hrs after deadline will be penalized by a 50% grade reduction.
>48 Hours Late	0%	Late submission will not be accepted or graded if late by >48 hours.

* *Students who are unable to complete an assignment on time for any reason should notify the instructor(s) and teaching assistant(s) by email 24 hours prior to the deadline, with a brief explanation for why the extension is needed.*

Classroom and Practicum Conduct and Attendance: The content of the course is unique. The schedule is dense. Missing more than 1 class per semester usually results in substantial under-performance. Students are expected to attend each synchronous in-person and virtual class. When extenuating circumstances arise that can make this difficult, please contact Instructor to notify to find a suitable solution (take a class virtually, watch recordings, etc.). If circumstances make you miss more than 3 classes during the semester, you may be overextended, and this would require discussing your options.

Virtual class attendance and practicums will be held to the same standards as in-class participation. We expect students to devote their full attention to virtual discussions without distractions. Students are also expected to read all assigned materials and review all asynchronous lectures, recordings, and readings before arriving to class. We expect the following code of conduct for all virtual sessions:

Activity/Event	*Conduct*
Participating During Zoom	Ensure that first and last names (and pronouns, if desired) are provided. When speaking, please ensure your video is on and your audio is unmuted. When not speaking, keep your video on and mute your audio to minimize background noise. Zoom invitations are posted to **Canvas > Zoom**.
Time Zone Differences	Synchronous materials will be performed according to Eastern Standard Time (EST). Please notify instructors if you are residing in a different time zone. Accommodations will be made as needed.
Zoom Session Recordings	All Zoom sessions will be recorded and posted to **Canvas > Zoom**. If you do not wish to be recorded, you are permitted to leave your video off or change your name to hide your identity.
Poor Internet Connection	In the event of poor internet connection or power outage, please email the instructor and teaching assistants. Students are expected to call directly into Zoom using the phone-in number for the remainder of class.

In-Class Participation	For synchronous in-class discussions and virtual practicums, students are expected to equally distribute and rotate team tasks. These include: a timekeeper, a scribe for tracking student discussion points, and a reporter to present discussion points to the class.

Readings, Resources, Texts and Additional Materials: Each Module contains a set of assignments, including specific activities, written, and reading assignments, peer feedback, posts, etc. Resources includes:

- Recent articles and online materials on data visualization and effective communication.
- Software and tools for graph development.
- Access to relevant nutrition datasets.

All materials will be made available on the Tufts Canvas site. Brief descriptions of the material and submission pages are provided below.

Materials	*Description and Location*
Learning Objectives	Learning objectives are outlined for each week. These objectives reflect the aims and goals addressed in all synchronous and asynchronous materials and activities for that Module. These objectives and their corresponding materials and assignments are outlined for each week at **Canvas > Modules**.
Lecture Notes	Each Module is supplemented by Lecture Notes, that contain essential concepts. Students are recommended to review lecture notes prior to Monday classes for general guidance throughout the course.
Reading List	Reading lists include readings essential for completing course assignments and additional resources for mastery development. Students are recommended to complete reading assignment related to each Module prior to Monday classes. Readings selected by instructor(s) are posted to **Canvas > Files > Readings**. Additional resources are provided in class and asynchronous recorded lecture materials.
Reading Assignment	For each required reading, we ask to rate and provide summary (see below); the responses will be collected and evaluated for future references, pre-assigned doc can be found in **Canvas > Announcements.**
Written Assignment	Students will complete a written assignment for each Module, which addresses the objectives for that week. Written assignment templates are posted to **Canvas > Files > Assignments**. Students should download and complete these templates each week. Written assignments should be submitted as Word documents by the time and day they are due to **Canvas > Assignments**.
In-Class Discussions	All synchronous materials will be dedicated to in-class small group activities and student assignment instructor feedback. The instructor will add these slides to **Canvas > Files > Class Slides** prior to Monday classes and updated as needed. Within each synchronous discussion, students will be asked to report group discussion notes, findings, and feedback in class. Instructors will try to provide an overview of these activities on Canvas prior to Monday classes. Instructors may ask you to report your feedback using online Google documents or spreadsheets outlined for each week at **Canvas > Modules**.
Practicum Participation	Practicum synchronous discussions will be held virtually on Thursdays and will be dedicated to refining technical skills, addressing questions, and providing peer feedback. All resources and class slides will be posted to **Canvas > Files > Practicum**. As with synchronous discussions, students will be asked to report group discussion notes, findings, and feedback during practicums. Instructors may ask you to report your feedback using online Google documents or spreadsheets outlined for each week at **Canvas > Modules**.

Student Portfolio	Each Module may include additional assignments, such as creating and updating Student Portfolio. The list of Student Portfolio can be found in **Canvas > Announcements.**
Peer Feedback	Students are required to provide peer feedback throughout the semester. Peer feedback will be submitted as comments to their partner's Portfolio, which can be found in **Canvas > Announcements**. Students will be given a template with prompt questions for responding to their partners' entries.
Lecture Recordings	We provide a set of recorded lectures posted to **Canvas > Zoom> Cloud Recordings**.
Away-From-Screen Time Reflection	Within lectures, students will be posed questions to consider during their personal reflection time. This should be done independently while disconnecting from computer-based activities. Please note – while some recordings might ask for students to submit responses, none are required.

Reading Assignment Template: We will assemble responses for required readings that should be completed using in-depth reading style and ask students to:

- Rate the relevance (**REL**) of the paper for your project using one of 3 options: 0-low; 1-medium; 2-high
- Rate your comprehension (**COM**) of this paper using one of 3 options: 0-low; 1-medium; 2-high
- State the time in minutes (**TIME**) taken to complete the reading in minutes
- Summarize (**SUM**) the most valuable lesson from this reading (1-2 sentences)

Paper	**Rating**	***Student Name***
Reading 1: Paper 1	**REL**	
	COM	
	TIME	
	SUM	

Reading Technique Suggestions: We suggest you master your reading techniques using 3 main reading styles: skimming, scanning, and in-depth reading and hone your skills in taking notes on reading (see http://owll.massey.ac.nz/study-skills/reading-styles.php). To learn more about reading techniques, see online tutorial: Reading techniques and notetaking for university students (online tutorial). Each style is used for a specific purpose:

Skimming means to read a page or handout - skip read - by reading the headings and first sentences of each paragraph or section. It usually takes three forms: Preview, Overview and Review (see skimming for more).

Scanning differs from skimming in that you do not deal with all of the content, but search through the material for a specific purpose or a specific word (or its synonym):

- finding the answer to a question
- seeking an appropriate quotation reference or statement
- locating names in a directory, words in a dictionary, prices in a catalogue, etc.

When you scan, you cover only as much of the content as is necessary to accomplish your purpose (see scanning for more).

In-depth (or detail) reading is the most involved and essential. The purpose of this style is to understand the concepts and arguments that the text contains. It should be done after skimming the text. See in-depth reading for more.

Required Reading List (all should be completed as in-depth reading and rated as described)**:**

To be developed, examples:

1. Ellison, A. M. 1993. Exploratory data analysis and graphic display. S. M.Scheiner and J.Gurevitch, editors. Design and analysis of ecological experiments. Chapman & Hall, New York.
2. Zhou B, Liang S, Monahan KM, EI-Abbadi N, Cruz MS, Chen Y, DeVane A, Reedy J, Zhang J, Semenova I, Montoliu I, Mozaffarian D, Wang D, Naumova EN. An open access data platform: The Global Nutrition and Health Atlas (GNHA). *Current Developments in Nutrition.* 2022; nzac031, (online Mar 11, 2022) https://doi.org/10.1093/cdn/nzac031
3. Zhou B, *et al.* Food and Nutrition Systems Dashboards: A Systematic Review. *Advances in Nutrition.* 2022; Volume 13, Issue 3, 748-757, https://doi.org/10.1093/advances/nmac022
4. He, K., & Meeden, G. (1997). Selecting the number of bins in a histogram: A decision theoretic approach. Journal of Statistical Planning and Inference, 61(49). https://doi.org/https://doi.org/10.1016/S0378-3758(96)00142-5
5. Castronovo, D. et al. 2009. Visualization of spatio-temporal disease patterns with dynamic maps. Environmental Health. Dec 30; 8:61. https://doi.org/10.1186/1476-069X-8-61
6. Andrienko, G., & Andrienko, N. Geospatial Visual Analytics Tutorial. http://www.peer.eu/fileadmin/user_upload/opportunities/metier/course4/c4_visual_analytics_geospatial.pdf
7. Wainer, H., & Spence, I. (2005). Graphical Presentation of Longitudinal Data. Encyclopedia of Statistics in Behavioral Science.
8. Chen, C. (2010). Information visualization. *Wiley Interdisciplinary Reviews: Computational Statistics*, *2*(4), 387–403. https://doi.org/10.1002/wics.89
9. Aguilar Rendón, N.; Morales Zaragoza, N.; Hernández Azpeitia, J. (2016). Infographics as a tool for business agreement. En Systems & design: beyond processes and thinking. Editorial Universitat Politècnica de València. 563-574. doi:10.4995/IFDP.2015.3376. https://riunet.upv.es/handle/10251/87874
10. Brown, R., Delectic, A., and T. Wong (2015). How to catalyze collaboration. *Nature*, 525, 315-317
11. B.I.U. Dur (2012). Analysis of data visualization in daily newspapers in terms of graphic design. Social and Behavioural Sciences 51, 278-283.
12. D. Barbarash (2016). Representation stigma: perceptions of tools and processes for design graphics. *Frontiers of Architectural Research*, 477-488.
13. Chui KKH, et al. 2011. Visual analytics for epidemiologists: Understanding the interactions between age, time, and disease with multi-panel graphs. PLoS ONE. Feb; 6(2): e14683. https://doi.org/10.1371/journal.pone.0014683
14. Tamara Munzner' book: Visualization Analysis and Design. https://www.amazon.com/Visualization-Analysis-Design-AK-Peters/dp/1466508914

Papers by former students to serve as an inspiration:

1. Alacorn T, Estrella B, Sempértegui F, Naumova EN. Effects of Data Aggregation on Time Series Analysis of Seasonal Infections. *International Journal of Environmental Research and Public Health.* 2020;17(16), 5887; https://doi.org/10.3390/ijerph17165887
2. Venkat A, Alarcon Falconi TM, Cruz M, Hatrwick MA, Anandan S, Kumar N, Ward HD, Balaji V, Naumova EN. Spatiotemporal clusters of cholera hospitalizations in Vellore, India. *International Journal of Environmental Research and Public Health.* 2019, 16(21), 4257; https://doi.org/10.3390/ijerph16214257
3. Hartwick M, Urquhart AE, Whistler CA, Cooper VS, Naumova EN, Jones SH. Forecasting *Vibrio parahaemolyticus* concentration in shellfish from a New England estuary. *International Journal of Environmental Research and Public Health.* 2019, 16(22), 4341; https://doi.org/10.3390/ijerph16224341
4. Singh GM, Becquart N, Cruz M, Acevedo A, Mozaffarian D, Naumova EN. Spatiotemporal and demographic trends and disparities in cardiovascular disease among older adults in the US based on 181 million hospitalization records. *JAHA*. 2019: 8:e012727 https://doi.org/10.1161/JAHA.119.012727

5. Zeng L, Ruan M, Liu J, Wilde P, Naumova EN, Mozaffarian D, Zhang FF. Trends in meat, poultry, and fish consumption in the United States, 1999-2014. *Journal of the Academy of Nutrition and Dietetics.* 2019: 1085-1098. https://doi.org/10.1016/j.jand.2019.04.004
6. Bai Y, Naumova EN, Masters WA. Seasonality in retail food prices, cost of nutrient and caloric adequacy in East Africa. *Science Advances.* 2020; 6(49) eabc2162 DOI: 10.1126/sciadv.abc2162 https://advances.sciencemag.org/content/6/49/eabc2162
7. Simpson R, Zhou B, Naumova EN. Seasonal synchronization of foodborne outbreaks in the United States, 1996-2017. *Scientific Reports.* 2020; 10, 17500. https://doi.org/10.1038/s41598-020-74435-9 (online Oct 15)
8. Simpson R, Zhou B, Alarcon Falconi TM, Naumova EN. An analecta of visualizations for foodborne illness trends and seasonality. *Nature Scientific Data.* 2020; **7,** 346. https://doi.org/10.1038/s41597-020-00677-x
9. Zhao Y, Naumova EN, Bobb JF, Claus Henn B, Singh G. Joint association of multiple dietary components on cardiovascular disease risk: a machine learning approach. *American Journal of Epidemiology.* 2021. https://doi.org/10.1093/aje/kwab004
10. Cliffer IR, Masters WA, Perumal N, Naumova EN, Zeba AN, Garanet F, Rogers BL. Monthly measurement of child lengths between 6-27 months in Burkina Faso reveals both chronic and episodic growth faltering. *American Journal of Clinical Nutrition*. 2021. https://doi.org/10.1093/ajcn/nqab309
11. Simpson R, Babool S, Tarnas M, Kaminski PM, Hartwick MA, Naumova EN. Signatures of cholera outbreak during the Yemeni Civil War, 2016-2019. *International Journal of Environmental Research and Public Health* (2nd Edition: Infectious Disease Modeling in the Era of Complex Data). 2022; 19(1): 378; https://doi.org/10.3390/ijerph19010378
12. Simpson R, Babool S, Tarnas M, Kaminski PM, Hartwick MA, Naumova EN. Signatures of cholera outbreak during the Yemeni Civil War, 2016-2019. *International Journal of Environmental Research and Public Health* (2nd Edition: Infectious Disease Modeling in the Era of Complex Data). 2022; *19*(1): 378; https://doi.org/10.3390/ijerph19010378
13. Simpson RB, Landone BN, Schipper KH, McCann JC, Tarnas MC, Naumova EN. Critical periods, critical time points and day-of-the-week effects in COVID-19 surveillance data: an example in Middlesex County, Massachusetts, USA. *International Journal of Environmental Research and Public Health* (*Special Issue on COVID-19*). 2022; 19(3):1321 https://www.mdpi.com/1660-4601/19/3/1321
14. Zhang Y, Simpson RB, Monahan KM, Sallade L, Sanchez E, Naumova EN. Evaluating Completeness of Foodborne Outbreak Reporting in the United States, 1998–2019. *International Journal of Environmental Research and Public Health* (2nd Edition: Infectious Disease Modeling in the Era of Complex Data). 2022; 19(5):2898 https://www.mdpi.com/1660-4601/19/5/2898

The SOLSTICE Approach: From 2019 to 2022, we conducted an NSF-funded study aimed at implementing, evaluating, and disseminating a transformative learning approach that offers students a solution-oriented, student-led, team-based, computationally enriched (SOLSTICE) training framework. The SOLSTICE approach emphasizes the incorporation of three components in the course curricula: 1) 3D Role Play to embody various research roles (such as a project leader and collaborators) and facilitate team-based problem solving; 2) Feedback-on-Feedback to enhance collaborative work among peers; and 3) Analytic Roadmap to support navigation and management of semester-long projects. We tested the proposed approach by collecting pre/post responses from over 250 students participating in ~30 courses led by 18 instructors stratified by course level (i.e., introductory, intermediate, and advanced) and degree of adoption of the SOLSTICE approach (i.e., fully adopted, partially adopted, and not adopted). With this approach we aim to mimic the “real-life” modern and future work environment and strive to provide skills needed for future workforce.

Peer (team) work: We expect student work in team settings to ensure that cooperative learning activities offer the following outcomes:

- Expose incomplete, inadequate, or inappropriate reasoning, which results in disequilibrium than can lead to better understanding.

- Through mutual feedback and debate, motivate each other to abandon misconceptions and search for better solutions.
- Master social processes, such as participation and argumentation, and cognitive processes, such as verification and criticism.
- Create a forum for discovery learning and encourage creative thinking.
- Facilitate the process of generating ideas.

3D Role Play: As part of the course design, each student will be trained in the following three roles: Principal Investigator, Collaborator, and Reviewer. To fulfill these roles, we will divide the class into groups of 3 students to allow for peer review and feedback on course assignments. Students will partake in each role, which are described in detail below.

Role	*Assignment Expectation*
Principal Investigator (PI)	Students will create and execute their own data visualization/analysis plan. Weekly written assignments have been developed to help assist in research ideation, management, and execution throughout the semester. We encourage students to report their barriers and challenges faced when completing their assignments.
Collaborator or Co- Principal Investigator (Co-PI)	As a Co-PI, students are expected to review homework assignments pasted to Discussion boards on Canvas each Friday and provide feedback prior to Monday class. Co-PIs will comment on students' assignments addressing points of confusion, clarity, or comprehension using prompted questions.
Reviewer	As a Reviewer, students are expected to comment on their Collaborators' submitted homework assignment before Monday classes or midterm. Reviewers will post comments directly to the Discussion forum, e-Portfolios, or posted rubrics answering prompted questions provided.

Team Formation: We aim to form teams and partner assignments based on commonalities and complementarity of students' self-reported academic interests, technical expertise, and research attitudes assessed at the start of the semester. We will collect students' comments, review feedback and responses, feedback-on-feedback, and adjust team compositions if needed. We see a great value in exposure to diverse opinions and perspectives.

Feedback: This course offers several forms of feedback: 1) direct instructor's, given on individual assignments; 2) peer's feedback prompted by structured questions for specific assignments; 3) group feedback will be provided during weekly in-class discussions and practicums, focusing of common challenges and mistakes, using students responses to questions posted in weekly assignments; 4) individual in-line comments and feedback will be provided to 2 major homework assignments, midterm and final submissions; and 5) structured group peers' feedback during class and practicum activities.

Form	**Timing**	**Focus**
General Summaries	Weekly during Monday Discussion sessions	Barriers and challenges from the prior week's written assignment submission. Examples of submitted visuals and comment on pros/cons during class. Feedback applies to all students even if your visual is not selected.
Written Feedback	For select assignments by instructors and TAs	Feedback addresses technical aspects of visualizations as well as the structure, content, and emphasis of student written briefs, figure legends, and brief titles.

Practicum Feedback	Weekly during Wednesday Practicum session	General and personalized feedback on assignment briefs and written work, applies to all students even if your visual is not selected.
Student-to-Student	During in-class sessions and for select assignments	Feedback to your classmates will be assessed and evaluated based on its quality not quantity.
Instructor/TA Office Hours	Weekly on 1st come, 1st served basis, or by appointment	Answering specific student questions. We encourage students to join as your peers' questions may reflect your own questions or challenges.

Summaries of Student Responses: In this course assignments we will collects questions related to barriers and difficulties in completing specific parts of the assignment. For example, in some assignments we ask to answer (in 1-3 sentences per question): What was the most challenging part on this assignment? Why was it challenging? For select assignments, we will use ChatGPT to summarize the submitted responses and compare the results from ChatGPT to your actual responses as part of course training objectives.

Public Feedback and Critique Rules: Our rules for a public critique are the following: a discussion should be inclusive and allow sides to provide the rationale and defend their positions; a critique should be constructive, articulate, and respectful of each other opinion.

Student Portfolio: For this course we created private (visible only to class participants) webpages to facilitate transparency, knowledge exchange, and opportunities to share your comments and constructive suggestions for improvements. Portfolio webpages include:

- Page 1 with Assignment 1 your name, photo, a graph or picture with a brief description of your professional interests;
- Page 2 with Assignment 2 – good graph, bad graph + comments;
- Page 3 with Assignment 3 – univariate structure-based graph + comments + revision;
- Page 4 with Assignment 4 – multivariate structure-based graph + comments + revision;
- Page 5 with Assignment 5 – simple scatterplot + comments + revision;
- Page 6 with Assignment 6 – updated scatterplot + comments + revision;
- Page 7 with Assignment 7 – Mid-term presentation with 6 slides and 3-min video;
- Page 8 with Assignment 8 – timeseries plot + comments + revision;
- Page 9 with Assignment 9 – a process-based visual + comments + revision;
- Page 10 with Assignment 10 – an infographic + comments + revision;
- Page 11 with Assignment 11 – Final presentation with 6 slides and 5-min video;
- Page 12 with your course impressions.

Links to Student Portfolio will be posted on **Canvas > Announcement**.

Student-led Projects and Presentations:

- Introduction to training materials and data sources.
- Developing student-led projects related to nutrition research (topic may include but not limited to exploring dietary patterns, analyzing the impact of interventions, and understanding nutritional pathways).
- Collaborative review of individual projects that involves creating and applying knowledge graphs, conceptual maps, or causal diagrams to a nutrition research question.
- Project presentations and discussions.

Course Schedule, Topics, Learning Objectives and Assignments: The schedule and material for individual Modules are subject to change at the instructor(s) discretion. Assignments that require feedback are due by the end of the week they are assigned, Fridays 9 pm EST. A few earlier assignments should be submitted before the Mondays' class by 1 pm. Students are expected to download the assignment submission template and submit their completed template as a Word document on Canvas to allow enough time for review prior to in-class presentation.

Week	*Module*	*Content and Assignment Description*
Jan 17	Welcome	• Review syllabus. • Identify your academic interests and goals for this course. • Fill in your Student Portfolio site Page 1. **Assignment 1.** Find a graph or a visual from public media or scientific literature that, in your opinion, reflects your academic interests and work for your in-class introduction. • Upload the selected visual on your Student Portfolio site Page 1.
Jan 22	Basic Concepts of Data Visualizations and Effective Communication	**Module 1. Basic Concepts of Data Visualizations and Effective Communication** • Define purpose, message, and audience • Define structure-, association-, process- based visuals • Introduce 4E principles of graphical presentation • Introduce Visual Brief as the final project **Practicum focus:** Principles for scientific writing for specialized and general audiences; setting up working teams (PI, co-PI, Reviewer); peer-review culture. **Assignment 2.** Select two visuals ("good" and "bad') from public media or scientific literature to share with class on Monday. Submit the visual to canvas along with your answers to prompted questions. • Upload on your Student Portfolio site Page 2.
Jan 29	Steps of Graph Construction	**Module 2. Steps of Graph Construction** • Use the steps of graph construction to read and create graphs. • Identify common problems of data visualization. • Identify best practices of data visualization using 4E principles. • Prepare data and preferred software. **Practicum focus: Coding workshop.** **Assignment 2:** For selected two visuals ("good" and "bad') revise a brief assessment using 4E principles and provide comments for your partner. Focus on the conveyed information, research questions, intended audience, and answer prompted questions. • Upload reflections on **Assignment 2** on your Student Portfolio site Page 2.
Feb 05	Visualizing Univariate Data Structures*	**Module 3. Visualizing Univariate Data Structures** • Identify types, properties, and purpose of structure-based univariate visualizations. • Interpret and assess the quality of univariate structure-based graphs. **Practicum focus: Coding workshop.** **Assignment 3:** Produce a structure-based graph of univariate data, emphasizing components, frequencies, and units. Provide two short (200 words) descriptions: one to a technical, scientific audience and one to a general audience. Descriptions should have clear research questions, data/methods, results, and messages. • Upload **Assignment 3** on your Student Portfolio site Page 3.
Feb 12	Visualizing Multivariate Data Structures*	**Module 4. Visualizing Multivariate Data Structures** • Identify types, properties (like hierarchy), and purpose of structure-based multivariate visualizations. • Interpret and assess the quality of multivariate graphs. **Practicum focus:** Feedback on **Assignment 3.**

		Assignment 4: Revise a univariate structure-based graph and produce a structure-based graph of multivariate data, emphasizing components, frequencies, and units. Provide two short (200 words) descriptions: one to a technical, scientific audience and one to a general audience. Descriptions should have clear research questions, data/methods, results, and messages. • Revise your graph and descriptions for **Assignment 3** and upload revisions on your Student Portfolio site Page 3. • Upload **Assignment 4** on your Student Portfolio site Page 4.
Feb 22 Thur	Visualizing Associations*	**Module 5. Visualizing Associations** • Identify types, properties, and purpose of association-focused visualizations. • Interpret and assess the quality of association-focused graphs. **Practicum focus:** Feedback on **Assignment 4.** **Assignment 5:** Produce a simple scatterplot with two variables, emphasizing the direction, strength, and shape of relationship. Provide two short (200 words) descriptions: one to a technical, scientific audience and one to a general audience. Descriptions should have clear research questions, data/methods, results, and messages. • Revise your graph and descriptions for **Assignment 4** and upload revisions on your Student Portfolio site Page 4. • Upload **Assignment 5** on your Student Portfolio site Page 5.
Feb 26	Visualizing Complex Associations*	**Module 6. Visualizing Complex Associations** • Add complexity to association-focused visualizations. • Interpret and assess the quality of association-focused graphs. **Practicum focus:** Feedback on **Assignment 5.** **Assignment 6:** Add complexity to a simple scatterplot with two variables by considering hierarchy, clustering, grouping. Provide two short (200 words) descriptions: one to a technical, scientific audience and one to a general audience. Descriptions should have clear research questions, data/methods, results, and messages. • Revise your graph and descriptions for **Assignment 5** and upload revisions on your Student Portfolio site Page 5. • Upload **Assignment 6** on your Student Portfolio site Page 6.
Mar 04	Visualization and Perception	**Module 7. Visualization and Perception** • Optimal use of space and color to visually encode your data • The trade-offs between changing a single view and multiple linked views, e.g. multi-panel plots • Ways to reduce the amount of data shown in each view. **Practicum focus:** Feedback on **Assignment 6.** **Assignment 7:** Prepare mid-term presentation (6 slides) and recording (3 minutes) following the Midterm Presentation rubric and first draft of a Visual Brief. **Note: this assignment is due on 8 March 2024 at 9:00 pm** • Upload **Assignment 7** on your Student Portfolio site Page 7.
Mar 11	**Midterm Presentations****	**Midterm**. *This assignment is graded.*
Mar 16	No Class	Spring Recess
Mar 25	Visualizing Timeseries Data*	**Visualizing Timeseries Data** • Identify types, properties, and purpose of timeseries data plots. • Interpret and assess the quality of timeseries data plots. **Practicum focus: Coding workshop.** **Assignment 8:** Produce a timeseries data visual. Provide two short (200 words) descriptions: one to a technical, scientific and one to a general audience. • Upload **Assignment 8** on your Student Portfolio site Page 8.
Apr 01	Process-Based Visuals*	**Visualizing Timeseries Data** • Identify types, properties, and purpose of process-based visuals.

		• Interpret and assess the quality of process-based visuals. **Practicum focus:** Feedback on **Assignment 8.** **Assignment 9:** Produce a process-based visual with two short (200 words) descriptions: one to a technical, scientific and one to a general audience. • Revise your timeseries graph and descriptions for **Assignment 8** and upload revisions on your Student Portfolio site Page 8. • Upload **Assignment 9** on your Student Portfolio site Page 9.
Apr 08	Infographics	**Infographics** • Identify types, properties, and purpose of infographics. • Interpret and assess the quality of infographics. **Practicum focus:** Feedback on **Assignment 9.** **Assignment 10:** Produce an infographic visual with two short (200 words) descriptions: one to a technical, scientific and one to a general audience. • Revise your process-based visual and descriptions for **Assignment 9** and upload revisions on your Student Portfolio site Page 9. • Upload **Assignment 10** on your Student Portfolio site Page 10.
Apr 15	No Class	Patriot's Day Observed – University Holiday
Apr 22	**Final Presentations Rnd. 1****	**Due: Fir April 19 2024 at 9:00pm -** *This assignment is graded.*
Apr 29	**Final Presentations Rnd. 2****	**Due: Fri April 26 2024 at 9:00pm -** *This assignment is graded.*
May 06	**Final Submission**	**Due: May 06 2021 at 11:59pm -** *This assignment is graded.* *Grades due May 13*

* For these six assignments we plan to provide detailed feedback.

** Please note that Midterm and Final Presentations are to be submitted ***before*** they are presented to allow enough time for Peer Review prior to in-class presentation.