


Course Syllabus

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Instructor	Matt Bhagat-Conway	Meeting days	Monday
Email	mwbc@unc.edu (mailto:mwbc@unc.edu)	Meeting time	2:30–5:00 PM
	New East 320 or zoom:	Classroom	New East 201
Office	https://go.unc.edu/bhagatconway  (https://go.unc.edu/bhagatconway)	Final presentation time	Monday, May 1 8:00–11:00 AM
Office hours	Mondays, 12:30-2:00 PM Thursdays, 9:30-11:30 AM		

Note: The first session will be held on Zoom, <https://go.unc.edu/bhagatconway> 
(<https://go.unc.edu/bhagatconway>).

Course Description

This course introduces the techniques and tools used to assemble, manage, and analyze many types of data used to support decision-making in urban environments. We will work with real-world datasets. Since these datasets are often messy and incomplete, an important part of the course will be learning to clean and analyze imperfect data. The goal of this course is to prepare students to apply urban data analytics in practice. More emphasis will be placed on practical applications of urban data analytics than on the theory underlying these methods. Students will also learn good coding practices for managing urban data science projects, including version control, documentation, and modular design.

The class has no formal prerequisites, and no programming experience is required. Undergraduate students at all levels are welcome to take this course.

Students should have laptop computers that they bring to class. Ideally, their computers will have sufficient memory and processing power to run [R](https://www.r-project.org/), [RStudio](https://www.rstudio.com/), and [QGIS](https://qgis.org/en/site/) with medium-sized datasets (any recent Mac or PC should be sufficient). Students should install these (free) programs before the first class, if possible, other. Students working on Windows machines should install git as well, either **directly from Git**, or by installing the **Windows Subsystem for Linux** (if you're not sure which you should install, you should probably install directly from Git).

If you do not have a laptop you can bring to class, or if you have a Chromebook or other system unable to run these applications, please contact me as soon as possible to discuss options.

Learning Objectives

By the end of this course, students will be able to

- Think about data and problem-solving using algorithms
- Write understandable and reproducible code to analyze urban data
- Manage that code in a version control system
- Perform basic exploratory urban data analysis
- Visualize urban data, including spatial data
- Analyze flow and network data
- Scrape structured and unstructured information from the internet
- Perform text analysis to make sense of unstructured text data
- Work with GIS datasets in a statistical programming environment

Major and Minor Requirements

This course fulfills the following curriculum requirements

- Urban Studies and Planning minor: this course can count as one of the 3 required PLAN electives
- Data Science minor: this course can be used as an elective

Course Materials

All required materials will be available on Canvas. There are no textbooks for this course. Readings should be completed before the class they are listed with.

Class Format

Class meetings will consist of lectures, hands-on exercises, and discussion. Please come to class ready to discuss the week's homework and any issues encountered. Hands-on exercises are critical to promote understanding of data science techniques and to troubleshoot inevitable issues. Students should bring their laptops to class; if this is hardship please contact the instructor immediately.

Course schedule

- **January 9:** Introduction to R, QGIS, Git, and GitHub, assist with installation and setup on student machines as needed. Introduction to course and brief discussion of data science ethics.
No class January 16 due to MLK Jr. day holiday
- **January 23:** Data science ethics, Git and Github continued
Readings (most on Canvas in the Data Science Ethics module, *How to Lie with Maps* on reserve at Davis Library):

Green, *The Smart Enough City*, ch. 1. (MIT Press, 2019)

Abebe, "Why AI Needs to Reflect Society" (Forbes, 2018)

O'Neil, "The Era of Blind Faith in Big Data Must End" (TED, 2017, video).

Monmonier, *How to Lie With Maps*, 2nd ed. skim ch. 1-4, 6, 10 (on reserve at Davis Library; if you have the third edition, skim ch. 1-4, 7, 11).

- **January 30, February 6:** Exploratory data analysis and visualization; applications of good coding practices and version control. Data cleaning.

Readings

Asmus, "Fuel usage," <https://metro council.org/Transportation/Performance/Travel-Behavior-Inventory/Data/Fuel-Usage.aspx> ↗ (<https://metro council.org/Transportation/Performance/Travel-Behavior-Inventory/Data/Fuel-Usage.aspx>)

Harris and Wertz, "Racial Differences in Economic Security: The Racial Wealth Gap"
<https://home.treasury.gov/news/featured-stories/racial-differences-economic-security-racial-wealth-gap> ↗ (<https://home.treasury.gov/news/featured-stories/racial-differences-economic-security-racial-wealth-gap>)

Homework 1 due January 31

No class February 13 due to well-being day. Enjoy your break!

*Homework 2 due **Thursday**, February 16*

- **February 20: Asynchronous online class: finding open data**
- **February 27, March 6:** Spatial data in R and QGIS.

Choose paper for urban data analysis and send to me by March 6

No class March 14. Happy spring break!

Homework 3 due February 28

Plumer and Popovich, “How decades of racist housing policy left neighborhoods sweltering.” *New York Times*, 2020. <https://www.nytimes.com/interactive/2020/08/24/climate/racism-redlining-cities-global-warming.html> ↗ (<https://www.nytimes.com/interactive/2020/08/24/climate/racism-redlining-cities-global-warming.html>)

Merriam and Al-Jamea, “Interactive graphic: see how impacts from NC poultry farms may extend for miles.” *Charlotte Observer*, 2022. <https://www.charlotteobserver.com/news/state/north-carolina/article269637806.html> ↗ (<https://www.charlotteobserver.com/news/state/north-carolina/article269637806.html>)

- **March 20:** Models, prediction, and linear regression

Urban data analysis critique due March 21

Readings

California Department of Housing and Community Development. *Affordable Housing Cost Study: Analysis of the Factors that Influence the Cost of Building Multi-Family Affordable Housing in California* (2014). **Pages 8-9, 19-46.** <http://www.hcd.ca.gov/policy-research/plans-reports/docs/FinalAffordableHousingCostStudyReport-with-coverv2.pdf> ↗ (<http://www.hcd.ca.gov/policy-research/plans-reports/docs/FinalAffordableHousingCostStudyReport-with-coverv2.pdf>)

- **March 27:** Analyze and visualize data on origins, destinations, and flows using R and QGIS.

Homework 4 due March 28

Final project proposal due April 1


Readings

Green, Horel, and Papachristos. Modeling Contagion Through Social Networks to Explain and Predict Gunshot Violence in Chicago, 2006 to 2014. *JAMA Internal Medicine*, 177(3), 326–328. 2017. <https://doi.org/10.1001/jamainternmed.2016.8245> ↗ (<https://doi.org/10.1001/jamainternmed.2016.8245>)

- **April 3:** Text analysis. Use regular expressions to parse text data, perform basic natural language processing

Homework 5 due April 4

Readings

Moosavi, S., Samavatian, M. H., Parthasarathy, S., & Ramnath, R. (2019). *A Countrywide Traffic Accident Dataset* (arXiv:1906.05409). arXiv. <http://arxiv.org/abs/1906.05409> 
(<http://arxiv.org/abs/1906.05409>)

- **April 10:** Raster datasets. Use raster spatial data in R and QGIS.

Homework 6 due April 18

- **April 17, 24:** Open lab, work on final projects
- **May 1:** Final project presentations. **8AM-11AM.**

Assignments and grading

Your course grade will consist of:

- **6 homework exercises**
 - Homework exercises are generally due every 2 weeks on Tuesday, and are based on the weeks' lecture topic. All homework assignments will be posted at least 2 weeks before the due date.
- **One critique of an existing urban data analysis**
 - You will find an existing urban data analysis, and critically evaluate it. What was the research question? Were the data and methods appropriate to address this question? How do you think this analysis should impact policy (if at all)?
 - You may find your analysis in the popular press, government reports, or the academic literature, but it should contain enough detail to evaluate the methods and data used.
 - You should submit your choice of analysis to me before you start, to ensure it fits the criteria for the assignment.
- **One independent project**
 - The final assignment is an independent project analyzing data you find to answer an urban-related question you develop.
 - This project will consist of a proposal, a final report (8-15 pages double spaced), and a 10-minute in-class presentation.
 - The project should use an existing dataset, analyzed using methods discussed in this class.
 - The project should include a discussion of policy implications of your results.
 - Before you submit your proposal, you *must* meet with me (in person or on Zoom) to discuss the project. You may either visit my office hours or set up an appointment at another time. You are of course welcome to meet with me as often as needed as you develop and complete the project.

Each graded component will contribute to the final grade as follows:

	Due	% Grade	
1 Homework 1: Version control	Jan 31	5%	
2 Homework 2: Exploratory data analysis	Feb 16	7%	
3 Homework 3: Spatial data	Feb 28	10%	All homework combined = 50%
4 Homework 4: Models and regression	Mar 21	8%	
5 Homework 5: Network analysis	Apr 4	10%	
6 Homework 6: Text analysis	April 18	10%	
7 Urban Data Analysis Critique	Mar 28	20%	
8 Final Project: Proposal	Apr 1	5%	
Final Project: Report	May 1	15%	
Final Project: Presentation	May 1	10%	

Note: Assignments will be considered on time as long as they are submitted by 8am the day *after* the due date—so an assignment due Feb 1 will be considered on time if it was submitted at 1:15 AM Feb 2, for example.

Final grades will be calculated as follows:

A A- B+ B B- C+ C C- D+ D F

93 –	90 –	87 –	83 –	80 –	77 –	73 –	70 –	65 –	60 –	< 60
100	92.99	89.99	86.99	82.99	79.99	76.99	72.99	69.99	64.99	

Late assignments

To keep the course on schedule, it is important that assignments be submitted on time. I understand that circumstances may occasionally arise that prevent you from turning in assignments on time. Thus, you may submit one assignment (other than the final project) up to one week late without penalty, although I would appreciate an email before the due date letting me know you will be turning it in late. Additional late assignments will receive a 10% deduction for each day late up to 5 days, after which they will not be accepted. (If you turn in multiple assignments late, I will apply the one-week grace period to whichever assignment will result in you having the highest grade.) Exceptions to this late work policy may be made on a case-by-case basis—please contact me as soon as possible if you anticipate needing an exception.

If you encounter technical difficulties that may prevent you from completing an assignment on time, please contact me as soon as possible for assistance. Depending on the nature of the problem, deadline extensions may be approved on a case-by-case basis. Approved deadline extensions due to technical difficulties will incur no late penalties and will not count as a late assignment.

University resources

In addition to class time and office hours, there are several resources on campus that may help you with the concepts and assignments in this course, and I encourage you to use them.

Davis Library Research Hub

<https://library.unc.edu/data/> 

[\(https://library.unc.edu/data/\)](https://library.unc.edu/data/)

The Research Hub is a service provided by UNC Libraries to assist students with questions about R, GIS, and statistics generally. The service is currently operating via video calls and online chat.

Odum Institute Online Statistics Help Desk

<https://odum.unc.edu/statistics-help-desk/> 

[\(https://odum.unc.edu/statistics-help-desk/\)](https://odum.unc.edu/statistics-help-desk/)

The Odum Institute provides online statistical support for R and statistics, generally for more advanced questions than the Research Hub can address. This may be useful when working on your final project.

Writing Center


writingcenter.unc.edu  [\(http://writingcenter.unc.edu\)](http://writingcenter.unc.edu)

The Writing Center provides one-on-one assistance with writing, editing, and proofreading; this may also be helpful for your final project.


Absences

I understand there are times when you may need to miss class for any number of reasons. If you are going to miss class, I would appreciate an email letting me know. I will attempt to work with you so you can keep up if you must miss class.

The University has a policy to request University Approved Absences (described below), but it is not necessary to do so—an informal email to me is fine. If you are ill or think you may have COVID-19, please do not come to class—let me know and we can make alternate arrangements.

University Approved Absences are defined by the university at [attendance.unc.edu](https://uaao.unc.edu)  [\(https://uaao.unc.edu/\)](https://uaao.unc.edu/):


- Authorized University activities
- Disability/religious observance/pregnancy, as required by law and approved by Accessibility Resources and Service and/or the Equal Opportunity and Compliance Office (EOC)
- Significant health condition and/or personal/family emergency as approved by the Office of the Dean of Students, Gender Violence Service Coordinators, and/or the Equal Opportunity and Compliance Office (EOC).

You can request a University Approved Absence through the University Approved Absence Office by using [this request form](https://unc-ch.formstack.com/forms/university_approved_absence_request)  [. \(https://unc-ch.formstack.com/forms/university_approved_absence_request\)](https://unc-ch.formstack.com/forms/university_approved_absence_request).


Spring 2022 course delivery

As long as it is possible to do so safely, we will be meeting in person this semester (other than two online class days noted above). I understand the ongoing COVID-19 pandemic may require changes to this plan and will be monitoring the situation closely. If I need to change the format of the course temporarily due to outbreaks of illness, I will announce this via email and the course Sakai site.

Honor code

All students are expected to follow the guidelines of the UNC honor code. In particular, students are expected to refrain from “lying, cheating, or stealing” in the academic context. If you are unsure about which actions violate the honor code, please see me or consult honor.unc.edu .

[\(https://studentconduct.unc.edu/\)](https://studentconduct.unc.edu/).


I will report any honor code violation to the [Office of Student Conduct](https://studentconduct.unc.edu/honor-system) .

[_ \(https://studentconduct.unc.edu/honor-system\)](https://studentconduct.unc.edu/honor-system).




For this course:

- You are permitted and encouraged to seek advice and suggestions from other class members on the written assignments and homework, unless specifically instructed otherwise. This may include exchanging drafts for feedback and/or proofreading. Everything you turn in and all analysis must be your own work.
- Virtually every programmer uses sites such as StackOverflow, etc., when encountering a new problem. You are welcome to do so as well; if you use code or a solution from any online resource in your assignment, please include a comment with the URL where you found the solution and a short description of what the code accomplishes.
- In all written and presented work, you must cite or otherwise fully attribute all ideas, data, and other information that are not your own. This includes information presented in tables, graphs, appendices, etc.

Title IX resources

The University is committed to providing an inclusive and welcoming environment for all members of our community and to ensuring that educational and employment decisions are based on individuals' abilities and qualifications. Consistent with this principle and applicable laws, the University's [Policy Statement on Non-Discrimination](https://unc.policystat.com/policy/4467906/latest/) , offers access to its

educational programs and activities as well as employment terms and conditions without respect to race, color, gender, national origin, age, religion, creed, genetic information, disability, veteran's status, sexual orientation, gender identity or gender expression. Such a policy ensures that only relevant factors are considered and that equitable and consistent standards of conduct and performance are applied.



If you are experiencing harassment or discrimination, you can seek assistance and file a report through the Report and Response Coordinators (see contact info at safe.unc.edu ) or the [Equal Opportunity and Compliance Office](https://adminliveunc-my.sharepoint.com/personal/mwbc_ad_unc_edu/Documents/Equal%20Opportunity%20and%20Compliance%20Office) , or online to the EOC at <https://eoc.unc.edu/report-an-incident/> .

Diversity statement


I value the perspectives of individuals from all backgrounds reflecting the diversity of our students and my goal is to create a **safe space for everyone in this class**. I broadly define diversity to include race, gender identity, national origin, ethnicity, religion, social class, age, sexual orientation, political background, and physical and learning ability. **Please let me know if there is anything I can do to improve, I appreciate suggestions.**

Accessibility resources and services

The University of North Carolina at Chapel Hill facilitates the implementation of reasonable accommodations, including resources and services, for students with disabilities, including mental health disorders, chronic medical conditions, a temporary disability or pregnancy complications resulting in barriers to fully accessing University courses, programs and activities.

Accommodations are determined through the Office of Accessibility Resources and Service (ARS) for individuals with documented qualifying disabilities in accordance with applicable state and federal laws. See the ARS Website for contact information: <https://ars.unc.edu/> , or email ars@unc.edu .




Counseling and Psychological Services

CAPS is strongly committed to addressing the mental health needs of a diverse student body through timely access to consultation and connection to clinically appropriate services, whether for short or long-term needs. Go to their website: <https://caps.unc.edu/> , or visit their facilities on


the third floor of the Campus Health Services building for a walk-in evaluation to learn more. Students can also call CAPS 24/7 at 919-966-3658 for immediate support.


Resources

Our purpose as professors is to help you to excel in this learning environment. Should you need further assistance beyond the help of the professor, please consult the following on-campus resources:

- **The Writing Center** provides one-on-one assistance to students. To make an appointment, browse the Writing Center's online resources, or submit a draft online. They have additional useful information, such as handouts on how to cite online. [unc.edu](http://writingcenter.unc.edu)  (<http://writingcenter.unc.edu>)
- **The Learning Center** offers individual consultations, peer tutoring, academic coaching, test prep programming, study skills workshops, and peer study groups. [unc.edu](http://learningcenter.unc.edu)  (<http://learningcenter.unc.edu>)
- **Campus Health** provides ambulatory primary medical care, mental health services and wellness programs along with selected specialty services. [unc.edu](http://campushealth.unc.edu)  (<http://campushealth.unc.edu>)

Acceptable use policy


By attending the University of North Carolina at Chapel Hill, you agree to abide by the University of North Carolina at Chapel Hill policies related to the acceptable use of IT systems and services. The Acceptable Use Policy (AUP) sets the expectation that you will use the University's technology resources responsibly, consistent with the University's mission. In the context of a class, it's quite likely you will participate in online activities that could include personal information about you or your peers, and the AUP addresses your obligations to protect the privacy of class participants. In addition, the AUP addresses matters of others' intellectual property, including copyright. These are only a couple of typical examples, so you should consult the full [Information Technology Acceptable Use Policy](https://unc.policystat.com/policy/6875241/latest/)  (<https://unc.policystat.com/policy/6875241/latest/>), which covers topics related to using digital resources, such as privacy, confidentiality, and intellectual property.

Additionally, consult the University website "[Safe Computing at UNC](https://safecomputing.unc.edu/)  (<https://safecomputing.unc.edu/>)" for information about the data security policies, updates, and tips on keeping your identity, information, and devices safe.

Syllabus changes











The professor reserves the right to make changes to the syllabus, including project due dates and test dates. These changes will be announced as early as possible.

Grade appeal process

If you feel you have been awarded an incorrect grade, please discuss with me. If we cannot resolve the issue, you may talk to our departmental director of undergraduate studies or appeal the grade through a formal university process based on arithmetic/clerical error, arbitrariness, discrimination, harassment, or personal malice. To learn more, go to the [Academic Advising Program](https://advising.unc.edu/faqs/academic-difficulty-appeals/)  (<https://advising.unc.edu/faqs/academic-difficulty-appeals/>)_website.

Course Summary:

Date	Details	Due
Wed Feb 16, 2022	 Homework 2 (https://uncch.instructure.com/courses/21227/assignments/173549)	due by 11:59pm
Tue Mar 1, 2022	 Homework 3 (https://uncch.instructure.com/courses/21227/assignments/173551)	due by 11:55pm
Tue Mar 29, 2022	 Homework 4 (https://uncch.instructure.com/courses/21227/assignments/173553)	due by 11:55pm
	 Urban Data Analysis Critique (https://uncch.instructure.com/courses/21227/assignments/173561)	due by 11:55pm
Tue Apr 5, 2022	 Final project proposal (https://uncch.instructure.com/courses/21227/assignments/173545)	due by 11:55pm
Thu Apr 7, 2022	 Homework 5: Text analysis (https://uncch.instructure.com/courses/21227/assignments/173555)	due by 11:55pm
Thu Apr 21, 2022	 Homework 6: Network analysis (https://uncch.instructure.com/courses/21227/assignments/173557)	due by 11:55pm
Tue Apr 26, 2022	 Homework 7: Raster analysis (https://uncch.instructure.com/courses/21227/assignments/173559)	due by 11:55pm
Thu Apr 28, 2022	 Final project writeup	due by 11:55pm

Date	Details	Due
Fri Apr 29, 2022	<p data-bbox="581 138 1382 163">https://uncch.instructure.com/courses/21227/assignments/173546</p> <p data-bbox="581 233 1382 300"> Final project presentation https://uncch.instructure.com/courses/21227/assignments/173544</p>	due by 3:05pm
Tue Jan 31, 2023	<p data-bbox="581 369 1382 474"> Homework 1: Git, RStudio, and QGIS https://uncch.instructure.com/courses/21227/assignments/173574</p>	due by 11:59pm
	<p data-bbox="581 537 1382 642"> Data Analysis Critique Weighted Average [20%] https://uncch.instructure.com/courses/21227/assignments/173543</p>	
	<p data-bbox="581 705 1382 810"> Homework 1 Weighted Average [4%] https://uncch.instructure.com/courses/21227/assignments/173548</p>	
	<p data-bbox="581 873 1382 978"> Homework 2 Weighted Average [7%] https://uncch.instructure.com/courses/21227/assignments/173550</p>	
	<p data-bbox="581 1041 1382 1146"> Homework 3 Weighted Average [7%] https://uncch.instructure.com/courses/21227/assignments/173552</p>	
	<p data-bbox="581 1209 1382 1314"> Homework 4 Weighted Average [7%] https://uncch.instructure.com/courses/21227/assignments/173554</p>	
	<p data-bbox="581 1377 1382 1482"> Homework 5 Weighted Average [10%] https://uncch.instructure.com/courses/21227/assignments/173556</p>	
	<p data-bbox="581 1545 1382 1650"> Homework 6 Weighted Average [10%] https://uncch.instructure.com/courses/21227/assignments/173558</p>	
	<p data-bbox="581 1713 1382 1818"> Homework 7 Weighted Average [5%] https://uncch.instructure.com/courses/21227/assignments/173560</p>	