

## DATA 400: Capstone in Data Analytics

Fall 2024

*(Last updated September 2, 2024; syllabus is subject to change)*

**Instructor:** Professor Eren Bilen

**Office:** Althouse 104

**Email:** [bilene@dickinson.edu](mailto:bilene@dickinson.edu)

**Phone:** 717-254-8162

**Office Hours:** [Calendly link](#)

Monday 2:30-4pm

Friday 9-10:30am

or by appointment

**QRA:** Quang Nguyen, [nguyenqm@dickinson.edu](mailto:nguyenqm@dickinson.edu)

**QRA Office Hours:** TBA

**Classroom:** Althouse 206

Tuesday and Thursday

10:30-11:45am

### Required Course Materials

- Ace the Data Science Interview: 201 Real Interview Questions Asked By FAANG, Tech Startups, and Wall Street; by Kevin Huo and Nick Singh
- BIG Jobs Guide: Business, Industry, and Government Careers for Mathematical Scientists, Statisticians, and Operations Researchers; by Rachel Levy, Richard Lauge-sen, Fadil Santosa
- The Effect, by Nick Huntington-Klein: [Link](#)
- Course webpage: [Github](#)

### Course Overview

This capstone course aims to provide students a foundation for the must-have skills needed towards becoming a successful and ethical data analyst. The course must be completed successfully as the final core requirement for degree in data analytics. During the course, we will revisit topics that you have learned in your prior data analytics core courses. By the end of the course, you will produce a clear output: a data science project showcasing your data analysis skills. You should consider this course and the project as an opportunity to practice your oral presentation, writing, and time management skills. Additionally, we will discuss strategies that will help you navigate the job market in data analytics.

A student who successfully completes this course should be able to do the following:

- Develop research questions systematically that are feasible to implement in a reasonable timeline, evaluate what makes a research question “good” or “bad”,
- Evaluate and characterize the limitations and uncertainty of statistical inference and machine learning models,
- Develop the ability to write about and present results from a data analysis project to a general and/or technical audience including its ethical implications.

## Course Policies

**Attendance Policy:** This course will be taught in person. Students are expected to attend all in-class meetings. While I will not take formal attendance, it is important for you to attend in class meetings and take notes. If you will be unable to attend a class meeting for any health-related issues or other emergencies, please contact me beforehand so that arrangements can be made.

**Use of Laptops, Tablets, and Phones:** Laptops and tablets are permitted for note-taking and coding during this course. In exchange for trusting you to use these devices, I ask that you not use them as distractions. I maintain the right to change this policy for individual students or for everyone if these tools become a problem during class. Phones are not permitted and should be put away in silent mode

**Grading:** Your course grade is based on assignments that are tied closely with a semester long course project. First, you will submit three potential research questions that will involve data analysis. These questions can be ideas that you came up with during your previous courses, or can be new ones. A grading rubric to be used to evaluate your ideas will be provided beforehand. You will receive feedback from me and from your peers for each of your ideas.

The first idea that you submit will form the basis of a “mini project” which you will work on individually during the first five weeks of the course. Your mini-project must be related to your three course disciplinary focus. At the end of Week 5, you will present your findings from your mini-project, involving exploratory data analysis and/or a model. Next, you will move onto your “big project”, which can be a continuation of your mini-project, or could be derived from the other two ideas you submitted. This project will be more involved, and must include both exploratory data analysis and an appropriate machine learning model.

Your final product will include a ReadMe guide explaining your data + how you obtained it, and a final presentation + slides. Your final presentation will be graded on hard skills (e.g., your model and how you implemented it) and soft skills (organization and clarity of your slides, delivery of your talk). Lastly, you will be matched with an alum who works either as a data analyst or works with data analysts at a company. You will network with them and interview them using questions that we will determine together in class.

Your participation in in-class discussions is important. You will be assigned readings (see the last page of the syllabus), and will be graded on how well you prepare and contribute to in-class discussions. The weights of the assignments are:

|   |                   |
|---|-------------------|
| Research questions (one-page) (x3) (15%):     | Due dates on Pg.6 |
| Mini-project presentation (10-15 mins) (15%): | Due dates on Pg.6 |
| Progress presentation (5-10 mins) (15%):      | Due dates on Pg.6 |
| Data collection + ReadMe guide (15%):         | Due dates on Pg.6 |
| Interview session (15%):                      | Due dates on Pg.6 |
| Final presentation (10-15 mins) (15%):        | Due dates on Pg.6 |
| Participation in discussions (10%)            |                   |

The following scale will be used to determine your final grade:

| Score            | Letter | GPA | Score            | Letter | GPA |
|------------------|--------|-----|------------------|--------|-----|
| $93 \geq x$      | A      | 4.0 | $73 \leq x < 77$ | C      | 2.0 |
| $90 \leq x < 93$ | A-     | 3.7 | $70 \leq x < 73$ | C-     | 1.7 |
| $87 \leq x < 90$ | B+     | 3.3 | $67 \leq x < 70$ | D+     | 1.3 |
| $83 \leq x < 87$ | B      | 3.0 | $63 \leq x < 67$ | D      | 1.0 |
| $80 \leq x < 83$ | B-     | 2.7 | $60 \leq x < 63$ | D-     | 0.7 |
| $77 \leq x < 80$ | C+     | 2.3 | $x < 60$         | F      | 0.0 |

**Teams:** It is important that you gain practice in team work, as data analysts often work in teams. You will be asked to form teams of two by the end of Week 6. A spreadsheet where you can enter your teams (along with your team names) will be provided. Between Week 3 and Week 6, you should chat with your classmates and find someone you share interests with. So, be on the lookout for what others are working on for their mini-project, get together, discuss what you can do for your “big project” as a team.

**Datacamp:** You will receive an invitation to Datacamp.com, which will grant you access to all their tutorials on data science for the duration of the semester. Use this as an opportunity to brush up the skills that might be necessary for your project, or to gain practice before your interviews.

**Writing in the Discipline (WiD):** This course is part of the WiD thread in the Data Analytics Major. Data scientists regularly report their analyses to their teams and other stakeholders. The types of writing that data scientists do takes on many different forms for a variety of audiences: graphical/visual representations, briefs, memos, reports, academic papers, code, data documentation, with audiences varying from developers, internal and external technical audiences to general audiences among others. Students completing the Data Analytics Major satisfy the WiD graduation requirement by maintaining a portfolio of assignments from the courses on the WiD Thread. This course will include one output (your data ReadMe guide) which will be added to your WiD portfolio, focusing specifically on:

- Communicating clearly the motivation and the goals of a data science project, providing a clear strategy for how the data was obtained,
- Clearly and transparently documenting and annotating data sources, data wrangling, and variable descriptions.

Moreover, an unsatisfactory WiD portfolio scores an automatic F in this course. The data analytics major at Dickinson achieves the Writing in the Discipline (WiD) graduation requirement via a collection of targeted assignments in several required courses. Each student stores these assignments in a WiD portfolio, and they officially achieve the WiD graduation requirement when that portfolio is assessed to be satisfactory by the senior seminar instructor. The instructor will make an initial determination of whether a student’s WiD portfolio is satisfactory by the end of the second week of classes. If it is unsatisfactory, the student will be given a chance to rectify the portfolio by completing one or more additional relevant WiD assignments. If the WiD portfolio is still unsatisfactory at the end of the semester, the student will receive an automatic F in this course.

**Ethics:** Data scientists must be aware of the ethical implications of their work. It must be the case that a data science project or algorithm objectively improves the well-being of the society without introducing bias, unfairness, or a violation of privacy. We will critically evaluate each of the ideas you propose and your project from such ethical lens, and discuss case studies that will help you become more aware of the ethical issues that you will most likely face working as a data analyst.

**Make-up:** If you must be away from campus on university business or due to an emergency, or you will miss a presentation day due to sickness, please reach out to me as soon as you can and provide documentation. The weight of the missed assignment will be shifted to other assignments.

## Getting Help

**Office Hours:** Please use this [Calendly link](#) to schedule an office meeting so that you have a confirmed slot scheduled with me. I will be holding office hours each week. Please see the first of page of the syllabus for my hours. I am also available by appointment. If there is a conflict and you are unable to make it to any of my hours, please feel free to send me an email. My availability outside office hours is not guaranteed, however I devote my attention fully to you during my office hours. Therefore, I highly encourage you to come to my office hours and ask questions.

## Other Important Information

**Referencing the Work of Others:** When submitting your work, you must follow common-sense ground rules. You must cite all your resources in any delivery of your work. Failure to cite your references constitutes plagiarism. If you have any questions about what constitutes plagiarism, you should reach out to me, or you may contact the writing center. Here is a [nice resource](#) that you can refer to for any questions regarding plagiarism.

**Statement on Disabilities:** Dickinson values diverse types of learners and is committed to ensuring that each student is afforded equitable access to participate in all learning experiences. If you have (or think you may have) a learning difference or a disability – including a mental health, medical, or physical impairment – that would hinder your access to learning or demonstrating knowledge in this class, please contact Access and Disability Services (ADS). They will confidentially explain the accommodation request process and the type of documentation that Dean and Director Marni Jones will need to determine your eligibility for reasonable accommodations. To learn more about available supports, go to [www.dickinson.edu/ADS](http://www.dickinson.edu/ADS), email [access@dickinson.edu](mailto:access@dickinson.edu), call (717) 245-1734, or go to the ADS office in Room 005 of Old West, Lower Level (aka “the OWLL”).

If you have already been granted accommodations at Dickinson, please follow the guidance at [www.dickinson.edu/AccessPlan](http://www.dickinson.edu/AccessPlan) for disclosing the accommodations for which you are eligible and scheduling a meeting with me as soon as possible so that we can discuss your accommodations and finalize your Access Plan. If test proctoring will be needed from ADS, remember that we will need to complete your Access Plan in time to give them at least one week’s advance notice.

**SOAR: Academic Success Support:** Students can find a wealth of strategic guidance by going to [www.dickinson.edu/SOAR](http://www.dickinson.edu/SOAR). This website for SOAR (Strategies, Organiza-

tion, and Achievement Resources) includes apps, tips, and other resources related to time management, study skills, memory strategies, note-taking, test-taking, and more. You will also find information aimed to help students “SOAR Through Academic Challenges,” as well as a schedule of academic success workshops offered through Academic Advising. If you would like to request one-on-one assistance with developing a strategy for a manageable and academically successful semester, email [SOAR@dickinson.edu](mailto:SOAR@dickinson.edu).

**Course Outline:** Below is a schedule for what will be covered in this course and the deadlines. There may be adjustments on the list during the semester depending on progress made in class. On Tuesdays, we will have an in-class discussion/mini-lecture on the week’s topic. Thursdays will consist of a project meeting session during which you will work on your project in class and ask me any questions that you might have about your project. Due dates for each assignment will be announced.

**Select tech topics:** You will cast two votes for what topics we will discuss during Week 7 and 9. Possible topics we can cover: Web-scraping, Artificial Neural Networks (ANNs), Geospatial data with Geopandas, Natural Language Processing (NLP), Advanced Regression, Causality & Natural Experiments. Feel free to email me if you have more suggestions.

**Other talks, events:** I highly encourage you to actively attend campus talks organized by the departments of Data Analytics, Math & CS, Economics, among others. You should network with presenters, and chat about how they approached tackling on their project. Your attendance on these talks will count towards your participation. We will have a discussion on what each talk was about and how the presenter collected and analyzed their data in the next class.

## Course outline

| Date                     | Topic                                       | Readings          | + to-do                                 | Due                |
|--------------------------|---|-------------------|---|--------------------|
| Week 1                   | Data Analyst job postings, Github portfolio | ADSI Ch 1,2- 1, 2 | work on job market items                |                    |
| Week 2                   | How to ask good research questions?         | 1, 2              | work on idea 1                          | idea 1             |
| Week 3                   | Revisiting Data 180                         | 1, 2              | start mini-project + work on ideas 2, 3 | idea 2 & 3         |
| Week 4                   | Revisiting Data 200                         | ADSI Ch 8         | cont. mini-project + ideas 2, 3         |                    |
| Week 5                   | Web-scraping with Selenium                  | 1, 2, 3           | wrap up mini-project                    |                    |
| <b>Oct 1 &amp; Oct 3</b> | <b>Mini-project presentations</b>           |                   | come + provide feedback                 |                    |
| Week 6                   | Revisiting Phil 258                         | 1, 2, 3, 4, 5     | form teams + start big-project          | teams              |
| Week 7                   | Revisiting Data 300                         | ADSI Ch 7, 1      | cont. big-project                       |                    |
| Week 8                   | <i>Fall break, Tuesday</i>                  |                   |   |                    |
| Week 9                   | Text Analysis                               | notes on github   | cont. big-project                       |                    |
| Week 10                  | Interactive visualization: Tableau, Shiny   | 1, 2, 3, 4        | cont. big-project                       | data sub (recomm.) |
| Week 11                  | Interactive visualization: Bokeh, Streamlit | 1, 2, 3, 4        | cont. big-project                       |                    |
| <b>Nov 12</b>            | <b>Progress presentations</b>               |                   | come + provide feedback                 | data sub (final.)  |
| Week 12                  | Data Science: The video game                | Link TBA          | cont. big-project                       |                    |
| <b>Nov 19</b>            | <b>Initiate interviews</b>                  |                   |   |                    |
| Week 13                  | <i>Thanksgiving break, Thursday</i>         |                   | cont. big-project                       | data readme        |
| Week 14                  | Wrap up projects                            |                   | cont. big-project                       | slides due         |
| <b>Dec 3</b>             | <b>Interview presentation</b>               |                   | come + discuss                          |                    |
| Week 15                  | Wrap up projects                            |                   | cont. big-project                       |                    |
| <b>Dec 18, W @2p</b>     | <b>Final presentation</b>                   |                   | come + provide feedback                 |                    |

ADSI: Ace the Data Science Interview