Quantitative Reasoning for Information Science

INFO 2301; Fall 2020

Monday, Wednesday, Friday; 11:30AM–12:20PM
This course will meet remotely
Zoom: https://cuboulder.zoom.us/j/99814555012
Canvas: https://canvas.colorado.edu/courses/62559

Abram Handler
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Course Description

This course introduces fundamental methods for reasoning quantitatively about data. It covers foundational concepts in data science, while also emphasizing complementary computational skills to apply these mathematical concepts to real problems. The course requires demonstrated proficiency with introductory computer programming. All coding assignments will be in Python 3.

The following topics will be covered, both as mathematical abstractions and as concrete computer programs:

- Introduction to mathematical data types
- Introduction to practical probability
- Introduction to combinatorics

By the end of this semester you will be able to:

- Translate between mathematical abstractions and concrete computer code
- Reason about problems involving uncertainty
- Apply quantitative concepts to real problems
- Randomly generate data and run simulations using a computer

Cumulative Instruction

This course covers foundational mathematical concepts that you will use again and again in working with data. In order to help you master the material, the course will be taught *cumulatively*. That means that quizzes, lectures and homeworks will revisit material from earlier in the semester, over and over again.

Because the course is *cumulative*, as you study for quizzes and tests, you'll want to remind yourself of everything we've covered in the course so far, as you will see questions from material across the semester. Additionally, if you don't understand a concept, it will be very important to come to office hours to get help. You will very likely see the concept on future assignments and assessments, not to mention in your future life as an information scientist!

Remote Course Policies

Class will meet three times per week (Monday, Wednesday, Friday) from 11:30AM–12:20PM on Zoom. Attendance is required during class time. This course will largely follow a "flipped classroom" model. You will watch pre-recorded lectures or read about concepts before class. During class, we will discuss and practice what you have learned from pre-recorded lectures and readings.

You will be expected to have watched the lectures and done the reading before the start of class. During class, there will be regular quizzes to assess what you have learned from pre-recorded lectures and readings. There will also be regular in-class activities. On random days, you will turn in these activities at the end of class time.

In order to fully participate remotely, students will need access to a personal computer with a web camera, a reliable high-speed internet connection, and a minimally disruptive background environment. You will often do coding assignments during class so please join with a computer and not a phone. Please email the instructor immediately if you expect any issues with remote participation.

Quizzes

This class will include many quizzes. These are a big part of the class, and will count almost as much as homeworks and exams towards your final grade. Quizzes might come at the start of class, and test material from the pre-recorded lecture. Or they might come at the end of class, and assess material from in-class exercises. Quizzes will be open book. You can use any materials from the course (or any website, though this will be not be necessary) to answer questions on a quiz. Because everyone sometimes has a bad day or needs more time to master a new concept, the instructor will automatically drop the lowest five quiz scores from your final grade.

In-class activities

This class will include many in-class coding activities, which you will complete in breakout rooms. You should expect to work with the people in the breakout room as you do the assignment. On random days, you will turn in in-class activities to Canvas at the end of class. On these days, everyone will need to submit their own copy of the activity. Activities that are turned in will be graded loosly based on effort and correctness (check minus, check, check plus), with an understanding that you have limited time to complete the work.

Attendance

You will take quizzes and complete activities during class. These will be used to calcuate your attendance score. You will be able to miss three quizzes across the semester without any attendance penalty.

Homeworks

This class will have homeworks every few weeks. You may complete the homeworks alone or with one partner. If you work with a partner, you must list the partner on your assignment.

Textbook and software

Assignments will use Python 3 in Jupyter notebooks.

There is no textbook required for class. Some readings will come from OpenIntro Statistics, 4th edition (which is available for free). There will be other required readings and materials which will be made available through Canvas.

Prerequisites

Requires prerequisite course of INFO 1201 or CSCI 1200 or CSCI 1300 or LING 1200 or ATLS 1300 (all minimum grade C-). Students should be proficient with Python programming. If you do not have experience

with coding, it will be very hard for you to take this class. If you have questions, please email the instructor.

Late work

The instructor understands that students are busy with many obligations. Therefore, across the whole semester, you will be allotted a total of five free late days to turn in assignments, if you turn in an assignment within 24 hours after the deadline you will be deducted 1 late day. If you turn in an assignment within 48 hours after the deadline you will be deducted 2 late days, and so on. If you have used five or fewer late days so far during the semester (including the most recent assignment) you will not be penalized for late work. However, after you have used up your late days, late homework will not count for credit except in special circumstances.

Grading

Final grades are calculated according to the following distribution:

- 5% Attendance (based on in-class quizzes and assignments)
- 25% Quizzes (online, via Canvas, during class)
- 30% Homework
- 10% Midterm Exam 1
- 10% Midterm Exam 2
- 20% Final Exam

Letter grades will follow a typical scoring distribution (A if >= 93%, A- if >= 90%, B+ if >= 87%, B if >= 83%, B- if >= 80%, C+ if >= 77%, and so on). Do not expect most grades to be curved, though exam grades may be curved if needed.

Computing Requirements

Students will need to use statistical computing software as well as teleconferencing software to participate in class. Jupyter notebooks written in Python 3 will be used for all in-class examples and assignments. The Anaconda distribution of Python 3.5 (or above) is *strongly* recommended to provide all of these programs and other libraries. Lectures will include exercises and presentations with the expectation that students participate with their own computers. If students do not have access to a computer to use for computing or Zoom, they should immediately email the instructor. Instructional support will only be provided for Anaconda and Python. Students who require technical assistance should email the instructors with the code and data they are working with, a summary of their debugging efforts to date, and attend an instructor's office hours.

Schedule

This course will be divided into three units. There will be an exam at the end of each unit.

Topic	Week	Dates	Details
Introduction	1	Aug 24 – Aug 28	Introductions, basic data types, Anaconda setup
Sets	2-3	Aug 31 – Sep 4	Definitions, set operations, intro to LaTeX
Vectors	4-5	Sep 7 – Sep 18	Definitions, vector operations, intro to markdown
Booleans	6	Sep 21 – Sep 25	Definitions, intro to Boolean logic, truth tables
Review & Midterm 1	7	Sep 28 – Oct 2	Review & take-home, open-book midterm #1

Unit 1: Fundamental data types

Topic	Week	Dates	Details
Random variables	7	Oct 5 – Oct 9	Definitions and expected value
Simulation	8	Oct 12 – Oct 16	Simulating data in Python, applications of simulation
Events	9	Oct 19 – Oct 23	Definition, independence, marginalization
Conditional probability	10	Oct 26 – Oct 30	Definition, applications, practice in Python
Bayes theorem	11	Nov 2 – Nov 6	Definition and applications, practice in LaTeX
Review & Midterm #2	12	Nov 9 – Nov 13	Review & take-home, open-book midterm #2

Unit 2: Probability

Topic	Week	Dates	Details
Permutations and combinations	14	Nov 16 – Nov 20	Definition, explanations, practice
Binomial distribution	15	Nov 23 – Nov 27	Definition, introduction to mean and variance
Review & Final Exam	16	Nov 30 – Dec 4	Review of course, prep for final exam

Unit 3: Combinatorics

Course Policies

In-Class Confidentiality

The success of this class depends on students feeling comfortable sharing questions, ideas, concerns, and confusions about assignments, work-in-progress, and their personal experiences. Students may read, comment, and run on classmates' writing, code, and other class-related content for the sole purpose of use within this class. However, students may not use, run, copy, perform, display, distribute, modify, translate, or create derivative works of another student's work outside of this class without that student's expressed written consent or formal license. Furthermore, students may not create any audio, video, or other records during class time without the instructor's permission nor may students publicly share comments made in class attributable to another person's identity without that person's permission.

Instructor Interaction

The instructor will check e-mail between 8:00 and 18:00 on non-holiday business days and try to respond to emails within 24 hours. E-mailing the instructor or coming to (remote) office hours are the best ways to get help and feedback outside of lecture.

Accommodations for Disabilities

We are committed to providing everyone the support and services needed to participate in this course. If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to the instructor in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the www.colorado.edu/disabilityservices/students. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website and discuss your needs with the instructors.

Religious Observance

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required assignments/attendance. If this applies to you, please e-mail the instructor as soon as possible to make the appropriate accommodations.

Classroom Behavior

Students and instructors each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran status, sexual orientation, gender, gender identity and gender expression, age, ability, and nationality. Class rosters are provided to the instructor with the student's legal name. The instructor will honor your request to address you by an alternate name or gender pronoun. Please advise the instructor of this preference early in the semester in order to make appropriate changes. For more information, see the policies on class behavior and the student code.

Harassment and Discrimination

The University of Colorado Boulder (CU Boulder) is committed to maintaining a positive learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct, discrimination, harassment or related retaliation against or by any employee or student. CU's Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU Boulder's Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should

contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the OIEC website.

Honor Code
All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the academic integrity policy of the institution. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, resubmission, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code Council as well as academic sanctions from the faculty member. Additional information can be found at honorcode.colorado.edu.

Illness
Should a student contract any illness that requires mandatory sequestration, intensive medical treatment, or extended convalescence and disrupts their ability to participate in class and complete assignments, the instructors will try to accommodate their condition without penalty with extensions and incompletes. This also applies if the student has a family member whose diagnosis, treatment, and recovery will affect their ability to participate. Students should notify the instructors as soon as possible of events that will impact their engagement with the class so that we can triage and develop an accommodation plan rather than scrambling at the end of the semester.

Canvas
Once the semester begins, this PDF version of the syllabus will be revised infrequently and any revised requirements will be posted as announcements and updated course schedule to Canvas. The instructor might make changes to the course's schedule, evaluation criteria, policies, *etc.* through announcements in class and on Canvas, so please check Canvas regularly. If you have questions, please email the instructor.

Acknowledgements

This syllabus was typeset in LaTeX using Overleaf with the fbb/Bembo font and is derived from the `memoir` styles adapted by Kieran Healy and Benjamin 'Mako' Hill. It is modified from a syllabus from Brian Keegan