Intro to Statistics and Data Science (STAT 202)

Fall 2022

Northwestern
Department of Statistics

Special Message:

THE COVID-19 PANDEMIC has been incredibly stressful and difficult for everyone. In order to face it, we have to trust each other, come together as a community, and extend as much compassion and understanding as we possibly can. Our highest priority will always be the health and well-being of our students, faculty, and staff. Our goal is to facilitate your learning experience. To that end, we have done our best to design an in-person course with some built in flexibility to help deal with both known and unknown challenges, pandemic related or otherwise. If you need any additional help or resources, or even an extension, please don't hesitate to let us know.

Course Description

THIS COURSE INTRODUCES students to the discipline of statistics as a science of understanding and analyzing data. Students will learn the importance of data collection and sampling, methods to analyze data, and how to use data to make inferences and conclusions about real world phenomena. Students will be introduced to the free statistical programming software, RStudio Cloud, to apply both descriptive and inferential statistics to real data sets.

When:
Sec20: Mon, Wed, Fri 9:00 - 9:50 am
Sec21: Mon, Wed, Fri 1:00 - 1:50 pm

Location: Swift Hall 107

Prerequisite: High School Algebra

Instructional Team

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Office Hours - held virtually
998 6392 3813

MAKE INDIVIDUAL APPOINTMENT/MEETING requests through Campuswire (discussed below) by selecting *Post to instructors and TAs*.

Course Goals

1. USE STATISTICAL SOFTWARE to manage and process data.
2. USE STATISTICAL SOFTWARE to perform exploratory data analyses. That is, explore data numerically and visually to gain understanding through data and generate hypotheses and inferences to later test.
3. RECOGNIZE THE IMPORTANCE of data collection, identify limitations in data collection methods, and determine how they affect the scope of inference.
4. BUILD A CONCEPTUAL UNDERSTANDING of the unified nature of statistical inference.
5. APPLY ESTIMATION AND TESTING METHODS to analyze single variables or the relationship between two variables in order to understand natural phenomena and make data-based decisions.
6. MODEL NUMERICAL RESPONSE VARIABLES using a single or multiple explanatory variables.
7. INTERPRET RESULTS in context without relying on statistical jargon.
8. CRITIQUE AND EVALUATE data-based claims and decisions.

"Numbers don't lie. That's where we come in."

Course Structure

THE BULK OF THIS COURSE will follow a flipped design. Meaning the majority of class time will be dedicated to working on activities. A typical class will devote 10-15 minutes to discussion/lecture with the remainder of the class devoted to working on activities where students will either work by themselves or in groups. Throughout the class we will discuss and review the work on the activities. In many cases we may come together to work on parts of an activity as a class.

Students are expected to prepare for class time by working through the indicated learning material prior to each class meeting.

Textbook (Free Online)

WE WILL BE USING Introduction to Statistics and Data Science[1] which is a free online book that we have been developing for this course.

[1] https://nustat.github.io/intro-stat-ds/

Software

WE WILL BE USING/INTRODUCING the free statistical software RStudio Cloud.

RStudio Cloud, https://rstudio.cloud/

Hardware

STUDENTS WILL NEED a laptop or Chromebook to be able to follow lectures and to work with RStudio Cloud to complete activities. If access to a laptop is an issue, then please contact the course instructor and we will work to find an accommodation.[2]

[2] This requirement will not prevent students from taking this course.

Asking Questions & Course Communication

This term we will be using Campuswire as our preferred platform for questions about activities, reading checks, and general course questions. The system is highly catered to getting you help quickly and efficiently from classmates and the instructional team. Rather than emailing questions to the instructional team, you should post your questions on Campuswire.

Enrollment Code: 7930

The instructional team will check Campuswire periodically and answer questions[3], but we strongly encourage students to answer each other's questions. To this end, student will be able to earn bonus points — see Canvas for details.

Questions concerning individual grades or appointments should be addressed through email.

[3] Please do not expect answers during weekends and evenings.

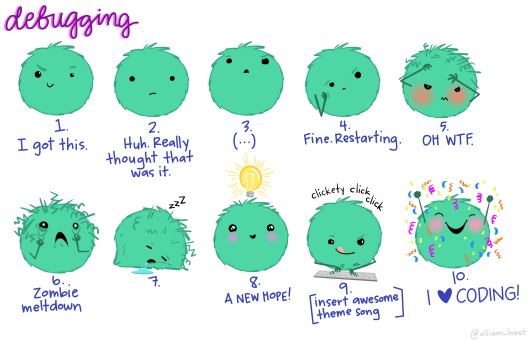
Tips for Success

- DEDICATE YOURSELF to being an active and engaged learner.
- PREPARE FOR CLASS by *reading and working* through code *before* class.[4]
- WORK IN GROUPS TO learn and complete activities[5].
- ASK QUESTIONS! Ask them during class, office hours, or on Campuswire[6].
- CONTRIBUTE TO a welcoming and inclusive learning environment.
- DON'T BE AFRAID to make mistakes, you learn from mistakes.

[4] Complete the reading checks!

[5] Don't just copy, help each other.

[6] Be active on Campuswire!



Debugging code is something we all struggle with and go through. It is a process and you will get better over time, but no matter your skill level there will always be struggles. Illistration by Allison Horst

Evaluation

STUDENTS WILL BE EVALUATED through (1) participation; (2) reading checks; (3) activities; (4) 3 exams; and a (5) final project.

Reading checks will be completed using "Tutorials" on RStudio Cloud and uploaded to the course Canvas page. All daily activities will be graded for completion. This doesn't mean that your solutions are correct, so make sure that you check them against the solutions.

There will be 3 in-class exams; they will be structured very similarly to your reading checks. Students will be allowed one 8.5 x 11 inch cheat sheet (front & back) on each in-class exams. The exams are not cumulative.

There will be 1 final group project. You will pick your own group of 3-5 people. More information will be provided later in the quarter.

Each reading check will be scaled to be worth 10 points.

Exam Improvement Policy

We have worked to develop a policy geared towards a growth mindset. That is, we want a policy where students clearly demonstrate that they have used the exam as a diagnostic tool to learn from and improve their understanding of statistics. There is NO final cumulative exam during the designated final exam time, instead you may choose to retake 1 exam during the exam time. This exam will replace your old score — only in cases where it is an improvement.[7]

[7] You must be on campus during the final exam time to retake exactly one exam.

Attendance Policy

While we do not collect formal attendance we do record participation. Implicit in the course design it is expected that you attend class each day to benefit from working with others — either by helping others or by helping others learn.

Late Policy

Any work submitted after the due date will incur a 10% late penalty. Absolutely no assignments will be accepted more than three days after the due date without prior approval. To account for these strict due dates, we will drop your 3 lowest reading check scores **and** your 3 lowest activities.

Grading

Grading Scale	
93.0 - 100%	A
90.0 - 92.9%	A-
87.0 - 89.9%	B+
83.0 - 86.9%	B
80.0 - 82.9%	B-
77.0 - 79.9%	C+
73.0 - 76.9%	C
70.0 - 72.9%	C-
60.0 - 69.9%	D
Below 59.9%	F

Category	Weight
Participation	5%
Activities	10%
Reading Checks	15%
Exam 1	20%
Exam 2	20%
Exam 3	20%
Final Project	10%

Final grades will be rounded to nearest tenth of a percent. There is NO curve to this course. Take advantage of the exam improvement policy and the extra credit opportunities.

There will be a few extra credit opportunities throughout the course. More information will be provided as the quarter progresses.

Students opting to take this course Pass/No Pass must (1) take and pass the final exam with at least a D and (2) earn a course grade of at least a D.

Academic Resources

Quarter-Long Study Groups offers peer-led academic support in a small-group setting for students enrolled in this course. If you join the program, you will meet weekly with about 5 to 8 other students and a peer facilitator[8]. During sessions, students review concepts, work through practice problems, raise questions, and work together to develop answers. Students register for the full quarter on CAESAR and weekly attendance is expected. Study Groups sessions are listed below course lecture and discussion sections (e.g., STAT 202-SG Peer-Guided Study Group: Introduction to Statistics and Data Science).

[8] A student who has already taken and done well in the course

Contact Borislava Miltcheva (pgsg@northwestern.edu) with any questions.

Drop-In Support (No Appointment Needed)

Drop-In Peer Tutoring is set up such that students can drop in to study alone or with others and ask questions of a peer leader who has done well in the class. Tutoring is provided for many of the introductory courses in Biology, Chemistry, Economics, Engineering, Mathematics, Physics, and **Statistics**. Check their website for a complete list of supported courses.

Contact Valerie Wolf (valerie.wolf@northwestern.edu) with any questions.

Accommodations

ANY STUDENT REQUESTING accommodations related to a disability or other condition must register with AccessibleNU[9] and provide the instructor with an accommodation notification from AccessibleNU, preferably within the first two weeks of class. All information will remain confidential.

[9] For more info visit http://www.northwestern.edu/accessiblenu/ or contact accessiblenu@northwestern.edu; 847.467.5530.

COVID-19 Policies

Classroom Expectations

STUDENTS, FACULTY, AND STAFF MUST COMPLY with University expectations regarding appropriate classroom behavior, including those outlined below and in the COVID-19 Code of Conduct[10]. With respect to classroom procedures, this includes:

[10] Internet search: "Northwestern Code of Conduct"

- Policies regarding masking and social distancing evolve as the public health situation changes. Students are responsible for understanding and complying with current masking, testing, Symptom Tracking, and social distancing requirements.
- In some classes, masking and/or social distancing may be required as a result of an Americans with Disabilities Act (ADA) accommodation for the instructor or a student in the class even when not generally required on campus. In such cases, the instructor will notify the class.

- No food is allowed inside classrooms. Drinks are permitted, but please keep your face covering on and use a straw.
- Faculty may assign seats in some classes to help facilitate contact tracing in the event that a student tests positive for COVID-19. Students must sit in their assigned seats.

If a student fails to comply with the COVID-19 Code of Conduct or other University expectations related to COVID-19, the instructor may ask the student to leave the class. The instructor is asked to report the incident to the Office of Community Standards for additional follow-up.

Class Attendance

Class sessions for this course will occur in person. Individual students will not be granted permission to attend remotely except as the result of an Americans with Disabilities Act (ADA) accommodation as determined by AccessibleNU.

Maintaining the health of the community remains our priority. If you are experiencing any symptoms of COVID **do not attend class** and update your Symptom Tracker application right away to connect with Northwestern's Case Management Team for guidance on next steps. Also contact the instructor as soon as possible to arrange to complete coursework. We plan to record sessions for students that miss to to COVID-19 related issues.

Students who experience a personal emergency should contact the instructor as soon as possible to arrange to complete coursework.

Should public health recommendations prevent in person class from being held on a given day, the instructor or the university will notify students.

Recording

Unauthorized student recording of classroom or other academic activities is prohibited.[11] Unauthorized recording is unethical and may also be a violation of University policy and state law.

Students requesting the use of assistive technology as an accommodation should contact AccessibleNU. Unauthorized use of classroom recordings — including distributing or posting them — is also prohibited.

Under the University's Copyright Policy, faculty own the copyright to instructional materials — including those resources created specifically for the purposes of instruction, such as syllabi, lectures and lecture notes, and presentations. Students cannot copy, reproduce, display, or distribute these materials. Students who engage in unauthorized recording, unauthorized use of a recording, or unauthorized distribution of instructional materials will be referred to the appropriate University office for follow-up.

[11] Including advising sessions or office hours.

Academic Integrity

STUDENTS ARE RESPONSIBLE for reading and understanding Northwestern's academic integrity policy[12]. Suspected violations of academic integrity will be reported to the Weinberg College Dean's Office[13].

[12] Found at http://www.northwestern.edu/provost/students/integrity/

[13] See your school's policies for more details, for example WCAS Policies.

Sexual Misconduct & Reporting

NORTHWESTERN UNIVERSITY IS COMMITTED to fostering an environment where students are safe and free from sexual misconduct. Confidential resources are available to those who have experienced sexual misconduct.[14]

Faculty, instructors, and TAs are **not** confidential resources and are required to report incidents of sexual misconduct, whether discussed in your assignments or in person, to the Title IX Coordinator, who can provide information about resources and options.

We encourage students who have experienced sexual misconduct to talk with someone to get support. For more information, including how to request interim protective measures and academic accommodations or file a complaint, visit the Get Help[15].

[14] See http://www.northwestern.edu/sexual-misconduct/get-help/confidential-support.html for details.

[15] http://www.northwestern.edu/sexual-misconduct/get-help/index.html

Discrimination & Sexual Harassment

NORTHWESTERN UNIVERSITY'S policies on Discrimination, Harassment, and Sexual Harassment apply to all members of the University community, including students, staff, and faculty. Any student, staff, or faculty member who believes that they have been discriminated against or harassed on the basis of his or her race, color, religion, national origin, sex, sexual orientation, gender identity, gender expression, parental status, marital status, age, disability, citizenship, veteran status, genetic information or any other classification protected by law, should contact the Office of Equal Opportunity and Access[16] or the Sexual Harassment Prevention Office[17].

Additional information about the University's discrimination and harassment policies, including the campus resources available to assist individuals with discrimination or harassment concerns, is available online on the Human Resources Equal Opportunity and Access website[18].

NORTHWESTERN STRICTLY PROHIBITS retaliation against any member of its community for reporting or inquiring about wrongful or unlawful activity. For more details see https://policies.northwestern.edu/docs/non-retaliation-policy-FINAL.pdf.

[16] 847.491.7458

[17] 847.467.6571

[18] http://www.northwestern.edu/hr/equlopp-access/index.html

Wellness & Mental Health Resources

NORTHWESTERN UNIVERSITY IS COMMITTED TO supporting the wellness of our students. Student Affairs has multiple resources to support student wellness and mental health. If you are feeling distressed or overwhelmed, please reach out for help. Students can access confidential resources through the Counseling and Psychological Services (CAPS), Religious and Spiritual

Life (RSL) and the Center for Awareness, Response and Education (CARE). Additional information on all of the resources mentioned above can be found here:

- https://www.northwestern.edu/counseling/
- https://www.northwestern.edu/religious-life/
- https://www.northwestern.edu/care/

Student Resources

Student Enrichment Services (SES) partners with FGLI students – pronounced figly – who are first-generation, lower-income, and/or DACA/Undocumented. SES works with these students to foster identity development, navigate campus resources, and build community. Through campus-wide partnerships and advocacy, SES strives to build an inclusive Northwestern community that is welcoming, supportive, and accessible for all students. SES can connect you to a number of resources (emergency aid assistance, books, supplies, laptops, food accessibility and much more!) both within the SES office and across campus. For more information please visit https://www.northwestern.edu/enrichment.

Tentative Course Schedule

Week	Date	Reading	Note
Week 01	Sept 21 (Wed)	Syllabus Day	
	Sept 23 (Fri)	Preface & Chap. 1	RStudio Cloud
Week 02	Sept 26 (Mon)	Sections 2.0 - 2.3	Data Visualization
	Sept 28 (Wed)	Sections 2.4 - 2.6	Data Visualization
	Sept 30 (Fri)	Sections 2.7 - 2.9	Data Visualization
Week 03	Oct 03 (Mon)	Sections 3.0 - 3.3	Data Wrangling
	Oct 05 (Wed)	Sections 3.4 - 3.9	Data Wrangling
	Oct 07 (Fri)	Chapter 4	Tidy Data
Week 04	Oct 10 (Mon)	**Exam 1**	
	Oct 12 (Wed)	Sections 5.0 - 5.1	Basic Regression
	Oct 14 (Fri)	Sections 5.2 - 5.4	Basic Regression
Week 05	Oct 17 (Mon)	Sections 6.0 - 6.1	Multiple Regression
	Oct 19 (Wed)	Sections 6.2 - 6.4	Multiple Regression
	Oct 21 (Fri)	Chapter 7	Randomization & Causality
Week 06	Oct 24 (Mon)	Chapter 8	Pop. & Generalizability
	Oct 26 (Wed)	Sections 9.0 - 9.1	Sampling Distributions I
	Oct 29 (Fri)	Sections 9.2 - 9.3	Sampling Distributions II
			Last day to drop
Week 07	Nov 01 (Mon)	**Exam 2**	
	Nov 03 (Wed)	Sections 9.4 - 9.7	Sampling Distributions III
	Nov 05 (Fri)	Chapter 10	Confidence Intervals I
Week 08	Nov 08 (Mon)	Chapter 10	Confidence Intervals II
	Nov 10 (Wed)	Chapter 11	P-values
	Nov 12 (Fri)	Chapter 12	Hypothesis Testing I
Week 09	Nov 15 (Mon)	Chapter 12	Hypothesis Testing II
	Nov 17 (Wed)	Chapter 12	Hypothesis Testing III
	Nov 19 (Fri)	Chapter 13	Putting it all together I
Week 10	Nov 22 (Mon)	**Exam 3**	
	Nov 24 (Wed)	Thanksgiving Break	NO CLASS
	Nov 26 (Fri)	Thanksgiving Break	NO CLASS
Week 09	Nov 28 (Mon)	**No Class**	Reading Week
	Nov 30 (Wed)	**No Class**	Reading Week
	Dec 02 (Fri)	**No Class**	Reading Week
Week 11	Dec 04 (Sun)	**Final Project Due Sun 11:59pm**	
	Dec 08 (Thur)	**Optional in-person Exam** 9 - 10 am or 3 - 4 pm	

Readings are all from the course textbook: Introduction to Statistics and Data Science.

There is almost always something due on Tuesday, Thursday, and Sunday.

What did you say?

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Statistics may be defined as "a body of methods for making wise decisions in the face of uncertainty." — W.A. Wallis