

**GEOL 145**  
**Lies, damn lies and statistics**  
Julien Emile-Geay  
Spring 2020

**General Information**

*Where/When* Class meets Mon/Wed/Fri, 11:00–11:50 am in ZHS 159.  
Discussions (2h / week) meet in ZHS 130. (register separately)

*Instructors*

Professor: Julien Emile-Geay ZHS 275 [julieneg@usc.edu](mailto:julieneg@usc.edu)  
Teaching Assistants: Shiying Nie ZHS 154 [shyingn@usc.edu](mailto:shyingn@usc.edu)

*Office Hours* On Zoom, by appointment.

*Zoom Links* Click here for [Mondays](#), [Wednesdays](#), [Fridays](#).

**Course Description**

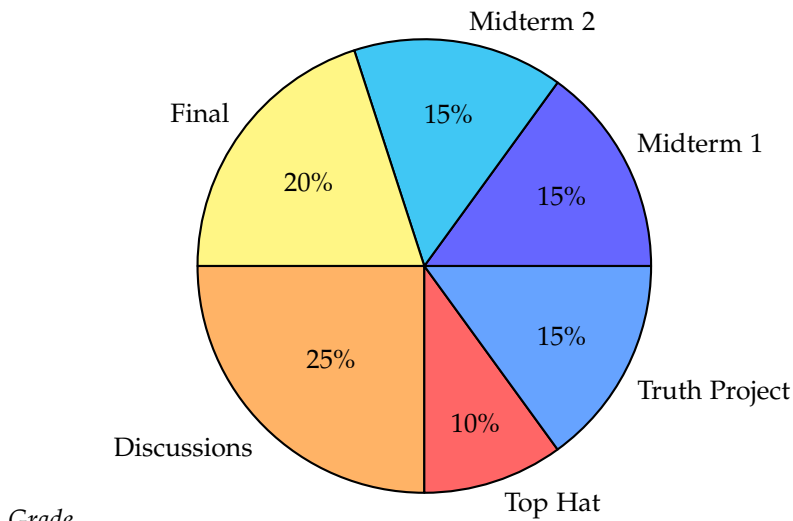
*Synopsis* No sooner have we entered the Information Age that we find ourselves shrouded in misinformation. “Alternative facts”, “post-truth” and “fake news” have replaced the age-old propaganda. With most of us increasingly seeking information from disjoint opinion bubbles, how is an informed person to make a rational judgment on hot-button issues such as climate change, evolution, gun violence, vaccine safety, genetically modified organisms, or nuclear risk? What separates truth from denial? Fact from fiction? Rational risk assessment from alarmism?

This class (GE-F Quantitative Reasoning) will introduce you to evidence-based methods to form reliable judgements on any topic where quantitative measurements exist. We will start with case studies where expert consensus and societal perceptions differ. Along the way, you will learn the basics of statistics and data science and how to apply them to almost any problem. In so doing, you will learn a bit about climate science, epidemiology, psychology, biology, and yes, maths. Finally, a series of case studies will apply the quantitative reasoning skills to a number of contemporary controversies.

*Course Catalog Description* Quantitative reasoning tools to form reliable judgements from quantitative evidence, discerning truth from lies, science from pseudoscience. Application to contemporary scientific and social issues.

*Learning Objectives* Students will learn to soundly reason from quantitative evidence. They will learn to: empirically analyze data; understand the logical structure of evidence-based arguments; deconstruct common logical fallacies that use the data incompletely or improperly (“lying with data”). Students will apply skills such as inductive, deductive, and mathematical reasoning to solve problems. Students will learn how to apply probabilistic reasoning to discriminate between competing hypotheses based on factual evidence. Students will learn how to critically evaluate quantitative claims in visual and written forms. Students will demonstrate proficiency in the visual display of quantitative information and associated plotting and editing software.

**Requirements** This course requires the ability to adjust your beliefs when exposed to evidence that contradicts prior opinions. A personal computer with Python 3 installed<sup>1</sup> is helpful, but not required.



**Grade**

The class is worth 4 units, which means that it requires substantial work. Attendance to discussion sections is mandatory (register separately, please).

Table 1: Numeric to letter grade conversion (cutoffs)

< 60	60	64	67	70	74	77	80	84	87	90	≥ 94
F	D-	D	D+	C-	C	C+	B-	B	B+	A-	A

**Rules** There are few rules, and they're all important. First, you should read the syllabus (if you've gotten this far, you're on the right track). Second, please check BlackBoard and make sure you receive its announcements. Third, please ask questions when you don't understand things; chances are you're not alone. Fourth, don't miss class or lab. Fifth, please do not email the instructor with questions whose answer is in the syllabus. Sixth, under no circumstance should you ever even think of haggling for your grade. Seven, read the syllabus once more (just in case). If you still have questions, we'll be glad to answer them.

## Reading

### Books

- Gonick, L. & Smith, W. *The Cartoon Guide to Statistics*, [URL](#), ISBN: 978-0062731029.
- Levitin, D. *A Field Guide to Lies and Statistics*. [URL](#), ISBN-13: 978-0241974872.

### Blackboard

Weekly readings will be posted on [BlackBoard](#). Check it!

<sup>1</sup><https://www.continuum.io/downloads>

# Course Schedule

## I SETTLED SCIENCE THAT UNSETTLES

### **Week 1 — 01/13/20— Introduction**

**Lectures** Class roadmap; Facts, myths, theories, measurements, experts. Climate denial.

### **Week 2 — 01/20/20— Vaccines, Nutrition**

**Lectures** (Monday: MLK day). Vaccine efficacy & denial. Tobacco Smokescreens.

### **Week 3 — 01/27/20— Life and death**

**Lectures** Sugar vs fat; Evolution & Creationism (Dr Nathan Smith, NHM); Truth Project problematization

**Assignment:** 5 quantitative claims you wish to investigate. (see [this](#) for inspiration)

**Discussion** 1: Why are vaccination rates declining?

## II DATA SCIENCE

### **Week 4 — 02/03/20— Principles of Data Science I**

**Lectures** Data Visualization. Data Visualization Gone Bad I. Data Visualization Gone Bad II

**Discussion** 2: Data analysis with Python

### **Week 5 — 02/10/20— Principles of Data Science II**

**Lectures** Exploratory Data Analysis. Probability calculus. Distributions.

**Assignment** G&S, chapter 1–5

**Discussion** 3: Visualizing your data (Truth Project).

### **Week 6 — 02/17/20— Principles of Data Science III**

**Lectures** Monday: President's Day. [missed lecture – flu] Normality.

**Assignment** G&S, chapters 9–11

**Discussion** 4: Exploratory Data Analysis

### **Week 7 — 02/24/20— Principles of Data Science IV**

**Lectures** Bayes' Theorem. Midterm 1. Significance Prosecutor's Fallacy.

**Assignment** G&S, chapter 6–8

**Exam** Wednesday **Midterm 1**

### **Week 8 — 03/02/20— Principles of Data Science V**

**Lectures** Correlations and p-hacking. Regression. Uncertainties.

**Assignment** G&S, chapter 6–8

**Discussion** 5: Statistical tests. p-hacking. Spurious correlations.

### III EVIDENCE-BASED REASONING

#### **Week 9 — 03/09/20— On the shoulders of giants**

**Lectures** Scientific reasoning; Good Science, Bad Science, and Ugly Science; Scientific Legitimacy

**Reading** **How do you know a paper is legit?**

**Discussion** 6: Regression.

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### **SPRING RECESS : March 15 – 22**

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#### **Week 10 — 03/23/20— Logical Reasoning**

**Lectures** Logical fallacies; motivated reasoning (Dr Jonas Kaplan, USC Psychology) cultural cognition;

**Assignment** Harstorf & Cantril, *They Saw a game*; **Fake Scientists**

**Discussion** 7: Expert identification game

#### **Week 11 — 03/30/20— Midterm 2**

**Lectures** Truth Project Update. Midterm review. Midterm 2.

**Reading:** **The Disinformation Playbook**

**Discussion** 8: The Disinformation Playbook

**Exam** Friday: **Midterm 2.**

### IV SPOTLIGHT: ANTHROPOGENIC CLIMATE CHANGE

We finish this class with a survey of climate science, one of the topics where the gap between scientific consensus is the largest. We explore the reasons for this gap in detail.

#### **Week 12 — 04/06/20— Climate Change**

**Lectures** Carbon dioxide greenhouse effect; climate data patchwork

**Assignment** Weart, *The Carbon dioxide greenhouse effect*

**Discussion** 9: Analyzing your data (Truth Project)

#### **Week 13 — 04/13/20— Man-made changes**

**Lectures** Planetary Energy Balance. Climate models. Attribution & Projections.

**Assignments** S. Weart, *The Carbon Cycle*.

**Discussion** 10: Reasoning with the temperature record

#### **Week 14 — 04/20/20— Climate Denial**

**Lectures** Hockey Stick & ClimateGate. The American Denial of Global Warming. Climate change in the media.

**Assignment** A. Hoffman, *Climate Science as Culture War*..

**Discussion** 11: Climate Tribalism ; Climate Narratives

### **Week 15 — 04/27/20— Agnotology**

**Lectures** Operation Infektion. Why do people believe impossible things? Truth Project presentations.

**Assignment** The Collapse of Western Civilization: A View from the Future.

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## **Wed May 6, 11-13 – Final Exam (cumulative) –**

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### **V TRUTH PROJECT**

15% of your grade will come from a team research project called the Truth Project. In it, you will pair up with another student and tackle 1-2 questions informed by your own curiosity. The projects need to involve:

- quantitative information (data)
- quantitative analysis
- visualization
- logical reasoning in the writing

You will share the result of your fact-finding missions via reports on Blackboard and oral presentations in the last week of class. The grade will be based 80% on content and 20% on the presentation.

### **VI TECHNOLOGY**

#### **Blackboard**

BlackBoard is our primary medium of communication outside the classroom. It is where I post class notes, announcements, and assignments. It is where you access that content and check your grades. **It is your responsibility to ensure that you receive BlackBoard announcements.** Make sure you enable email notifications, and importantly, make sure your inbox is not full. If you have a doubt about when an assignment is due, go check it on BlackBoard. Also note that BlackBoard messages are richer than the email notifications they generate. Frequently, the announcements will contain links to content archived on BlackBoard – those links will not appear in the emails. If the email digest you read does not make sense, please check it on BlackBoard; it might have the answer you need over there. If it still doesn't, please email me.

#### **Top Hat**

The tool we will use to gather live, in-class feedback is called **Top Hat**. You may submit your responses in one of three ways: Text messages, a Smartphone App, or a Web browser. In case you have not received an invitation to join the course on Top Hat, here's how to **get started**.

The economics are as follows: \$20 for a semester-long license or \$38 for a 5-year license (unlimited number of classes). **Purchase of a license is required to get in-class discussion points (10% of the grade).** Our class registration code is 054406.

#### **Email etiquette**

Email is a relatively new advent in the world of education. It allows an unparalleled level of access to professors, which has both pros and cons. In some cases you will spot a mistake of mine in an assignment or a grade, and pointing it out will save everyone a lot of time. In many cases, however, emails unnecessary clog my inbox. Here are some rules to use email wisely:

- Check BlackBoard first. Chances are the answer you seek is already there.
- Direct all lab-related queries to your TA.
- Direct all Top Hat-related queries to [support@tophat.com](mailto:support@tophat.com), unless they tell you to contact me.

Emails that break any one of these rules will not receive an answer. If you can spare the time, please come to office hours or see me after class. I'd much rather talk to a human than a computer, and I have yet to bite a student. Other email etiquette tips may be found [here](#).

### **Laptops & Tablets**

Laptops and tablets look way cool, but they have proven far less effective than good old pen&paper at information retention. Moreover, their use in the classroom can be disruptive to you and people around you if you use them for activities unrelated to the class. Please exercise best judgment and be considerate of others around you.

## **VII ACADEMIC CONDUCT**

### **Plagiarism**

Presenting someone else's ideas as your own, either verbatim or recast in your own words, is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in [SCampus](#) in Section 11, [Behavior Violating University Standards](#). Other forms of academic dishonesty are equally unacceptable. See additional information in [SCampus](#) and university policies on [scientific misconduct](#).

### **Discrimination**

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the [Office of Equity and Diversity](#) or to the [Department of Public Safety](#). This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The [Center for Women and Men](#) provides 24/7 confidential support, and the [sexual assault resource center webpage](#) describes reporting options and other resources.

### **Support Systems**

#### **Counseling and Mental Health** (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

<https://studenthealth.usc.edu/counseling>

#### **National Suicide Prevention Lifeline** –1-800-273-8255 – 24/7 on call

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

<http://www.suicidepreventionlifeline.org>

#### **Relationship & Sexual Violence Prevention Services (RSVP)** – (213) 740-9355(WELL), press "0" after hours – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

<https://studenthealth.usc.edu/sexual-assault>

#### **Office of Equity and Diversity (OED)** (213) 740-5086. Title IX Office – (213) 821-8298

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. <https://equity.usc.edu/>, <https://titleix.usc.edu>

#### **Reporting Incidents of Bias or Harassment** (213) 740-5086 or (213) 821-8298 Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response. [https://usc-advocate.symplicity.com/care\\_report](https://usc-advocate.symplicity.com/care_report)

#### **The Office of Disability Services and Programs** - (213) 740-0776

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking

needs, assistance with architectural barriers, assistive technology, and support for individual needs. <https://dsp.usc.edu>

**USC Campus Support and Intervention** - (213) 821-4710

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student. <https://campussupport.usc.edu>

**Diversity at USC** - (213) 740-2101 Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students. <https://diversity.usc.edu/>

**USC Emergency** UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. <https://dps.usc.edu>, <https://emergency.usc.edu>

**USC Department of Public Safety** - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call. Non-emergency assistance or information. <https://dps.usc.edu>

**Office of the Ombuds** - (213) 821-9556 (UPC) / (323-442-0382 (HSC) A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern. <https://ombuds.usc.edu>

## **GradeBuddy**

The following is a reminder from Academic Policies memo 11/25:

*Any student selling or distributing notes taken in a classroom is in violation of the University's Academic Integrity policy and is subject to university sanctions. This policy is clearly stated in Section 11.12 of the student handbook, **SCampus**, which identifies the following as violations of community standards:*

- Acquisition of term papers or other assignments from any source and the subsequent presentation of those materials as the student's own work, or providing term papers or assignments that another student submits as his/her own work.*
- Distribution or use of notes or recordings based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes, but is not limited to, providing materials for distribution by services publishing class notes. This restriction on unauthorized use also applies to all information which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the Internet or via any other media. (See Section C.1 Class Notes Policy.)*
- Recording a university class without the express permission of the instructor and announcement to the class. Recording can inhibit future free discussion and thus infringe on the academic freedom of other students as well as the instructor.*