**CLEAR THINKING IN THE AGE OF DATA OVERLOAD**[1]

More than at any time in history, we are awash in data and information. Every day we are bombarded with assertions and recommendations claiming to be based on data--in news reports, commercial advertising, even at the doctor's office. How do we make sense of it all? Given the innate limitations on human processing ability, how do we avoid feeling overwhelmed? Given the distortions built into our perceptions and judgments, how do we steer clear of cognitive errors? This course will discuss how to spot irrelevant information and misleading claims, ultimately improving our ability to make rational choices in a challenging environment.

Requirements:
I will distribute notes for each class. Students may want to have a copy of:

> Bergstrom, Carl T., and Jevin D. West, *Calling Bullshit—the art of skepticism in a data-driven world*, Random House, 2020. Describes the many deceptions in our information landscape, and how not to be fooled by them.

**CLASS 1: February 1**
Summary
1. We are surrounded by more and more data and information of all kinds; this can overload our attentional system.
2. Some of this is information false and misleading
3. The internet, Twitter, Facebook and the like made this worse, but humans have faced information overload for a long time.
4. Data overload is not new: For at last 500 years, writers have been complaining about the overwhelming number of books, pamphlets, etc. being pubished, and the difficulty of managing the data flow.
5. Humans evolved to process a limited amount of information, and to focus on one task at a time.
6. Built-in cognitive biases affect how we process information
7. We can learn to become better consumers of data
   - being aware of our own biases
   - entertaining multiple hypotheses
   - making ballpark estimates
8. What causes what? Correlation and causation

Resources:
Bergstrom, Carl T., and Jevin D. West, Calling Bullshit—the art of skepticism in a data-driven world.

Calling Bullshit website. The website for Bergstrom and West's 2017 course at the University of Washington, including videos of their lectures, case studies, and syllabus.
https://www.callingbullshit.org/syllabus.html

Daniel Levitin, The Organized Mind, chapter 1.

Steven Pinker, "Rationality," lecture 7, "Correlation and causation."

The Thinking Shop, "Cognitive Biases Wall Poster."

**CLASS 2 February 2: Data Visualization**

Summary

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1. Good data graphics can convey important information quickly
2. But graphics can also mislead, either intentionally or accidentally
3. Principles of good data graphics:
   - data graphics should be about data, not decoration
   - data graphics should make it easier, not harder, to interpret the data
   - graphical choices should be consistent with story being told

Resources:
Bergstrom, Carl T., and Jevin D. West, Calling Bullshit—the art of skepticism in a data-driven world.

Calling Bullshit website. See especially "Tools and Tricks."
https://www.callingbullshit.org/syllabus.html

Steven Pinker, "Rationality," lecture

**CLASS 3 February 3: Biases, heuristics, and distortions**

Summary

1. Rational choice theory tells us how we should make choices
2. This class will discuss departures from this model, that is, cognitive distortions and other factors in how people actually make choices
3. Common biases, illusions, and fallacies
   - confirmation bias
   - arguing ad hominem
   - fallacy of a priori and post-hoc probabilities (Texas sharpshooter fallacy, stock picker fallacy, illusory correlations)
   - loss aversion
   - framing
   - misperceptions of chance: gambler's fallacy, cluster illusion, neglecting regression to the mean
   - sunk cost fallacy
   - base-rate neglect
   - "law of small numbers"
   - Illusions of nonrandom clustering (hot hand illusion)

4. 3. Common heuristics used in place of careful analysis:
   - representativeness heuristic
   - availability heuristic
   - anchoring and adjustment

5. 4. Social and political bias

Resources:

Bergstrom and West, Calling Bullshit, chapter 7
Calling Bullshit website, class __

Kahneman, Thinking Fast and Slow.

Pinker, "Rationality," lecture 9, "Heuristics, Biases, and Cognitive Illusions"; lecture 13, "Social and Political Bias."

Thaler and Sunstein, *Nudge: improving decisions about health, wealth, and happiness.*

Online:
"How do you know if a paper is legit?"
https://www.callingbullshit.org/tools/tools_legit.html

**CLASS 4 February 4:**

Summary
1. What makes a good forecaster?
2. Rationality in the time of COVID
3. Thinking rationally about risk
   - cognitive distortions relating to risk
   - low-probability, high-consequence events
   - disasters

Resources

Bergstrom, Carl T., and Jevin D. West, *Calling Bullshit—the art of skepticism in a data-driven world.*

Calling Bullshit website.
https://www.callingbullshit.org/syllabus.html

Clearfield, Chris, and András Tilcsik, *Meltdown: what plane crashes, oil spills, and dumb business decisions can teach us about how to succeed at work and at home*

Harford, Tim, "Danger: rocks ahead!" Cautionary Tales podcast, Nov. 15, 2019
https://podcasts.google.com/feed/aHR0cHM6Ly9mZWVkcy5tZWdhcGhvbmUuZm0vY2F1dGlvbmFyeXRhbGVz/episode/ODczNDIwYTAtY2FhNS0xMWU5LTlkYWQtNGYxYmI1MTc3ODdi?sa=X&ved=0CAUQkfYCahcKEwjI3_3TuuztAhUAAAAAHQAAAAAQAw

Meyer, Robert, and Howard Kunreuther, *The Ostrich Paradox: Why we underprepare for disasters,*

Philip E. Tetlock and Dan Gardner, *Super Forecasting—the art and science of prediction*

References:

Bergstrom, Carl T., and Jevin D. West, *Calling Bullshit—the art of skepticism in a data-driven world,* Random House, 2020. Describes the many deceptions in our information landscape, and how not to be fooled by them. Excellent exposition, with good links to key statistical concepts.

Clearfield, Chris, and András Tilcsik, *Meltdown: what plane crashes, oil spills, and dumb business decisions can teach us about how to succeed at work and at home*, Penguin Books, 2018. Explains with convincing examples how complexity causes failure in piloting aircraft, medical treatment, and other settings.

Harford, Tim, *How to Make the World Add Up: ten rules for thinking differently about numbers*, Bridge Street Press, 2020. Diverting and informative. Harford is a columnist for the Financial TImes, and the author of several successful podcasts on critical thinking. A relatively quick read.

Kahneman, Daniel, *Thinking, Fast and Slow*, Farrar, Strauss, and Giroux, 2011. Kahneman is a cognitive psychologist who has reshaped his field, and several others as well, including economics, for which he was awarded the Nobel Prize in 2002. It is difficult to overstate Kahneman's importance to the study of how we think and make decisions in the real world. He wrote this book to introduce his ideas to a popular audience, and it does that well.

Levitin, Daniel, *The Organized Mind:* thinking straight in the age of data overload, Dutton, 2016. Levitin is an important neuropsychologist with many insights from his field about how to cope in this data-flooded era. Clear and well written, though also long and information-dense, so takes time to go through.

Meyer, Robert, and Howard Kunreuther, *The Ostrich Paradox: Why we underprepare for disasters,* Wharton School Press, 2017. Explains the difficulty of make decisions in the case of high-consequence low-probability events. Clear and concise.

Priest, Graham, *Logic—A Very Short Introduction*, Oxford, 2017. Good coverage of most topics in logic, though too dense for the average reader.

Silver, Nate, *The Signal and the Noise: why so many predictions fail—but some don't*, Penguin Press, 2012. After making his reputation in sports statistics, Silver expanded his scope to politics, where in the 2012 Presidential election, he called every state correctly. This book explains how he thinks about data, how to distinguish signal from noise, and how to improve our predictions. A classic.

Spiegelhalter, David, *The Art of Statistics—learning from data*, Penguin, 2019. Relax. Despite the title, this book is fun to read, and only slightly technical. Spiegelhalter is one of today's best expositors on statistics.

Tetlock, Philip E., and Dan Gardner, *Super Forecasting—the art and science of prediction*, Broadway Books, 2015. On forecasting, what makes a good forecaster, as well as why the usual experts are not good forecasters. Best book on the subject.

Thaler, Richard H., and Cass R. Sunstein, *Nudge: improving decisions about health, wealth, and happiness*, Penguin Books, 2007. Shows how people routinely make bad decisions about their own finances, retirement decisions, eating habits, health care, education, and risks, and how they can be steered toward better decisions. Particularly good on public policy.

The Thinking Shop, "Cognitive Biases Wall Poster." Just the thing for identifying the common cognitive biases. They also offer a Logical fallacies wall poster, and a critical thinking card deck.
https://thethinkingshop.org/products/logical-fallacies-wall-poster?pr_prod_strat=copurchase&pr_rec_pid=4526031274028&pr_ref_pid=4526619131948&pr_seq=uniformS

Tufte, Edward, *The Visual Display of Quantitative Information*, Cheshire Press, 1983. The most important book on data graphics ever published, this book set off the recent wave of attention to data graphics. Filled with illuminating examples of good and bad data graphics, exceptionally well reproduced. I don't endorse every one of Tufte's principles for graphic clarity, but nonetheless a must-read for those serious about data graphics. Named to several lists of best books of the twentieth century.

Warburton, Nigel, *Thinking from A to A*, Routledge, 1996. Clear concise definitions of terms used in argument and debate.

Online:

Calling Bullshit website. The website for Bergstrom and West's 2017 course at the University of Washington, including videos of their lectures, case studies, and syllabus.
https://www.callingbullshit.org/syllabus.html

Steven Pinker, “Rationality,” Excellent set of 24 lectures for his Harvard undergraduate course in rational thinking given in spring semester 2020. Although Pinker did not require prior preparation in mathematics, the lectures can be dense, and he moves quickly, so some background in math including probability would be helpful.
https://harvard.hosted.panopto.com/Panopto/Pages/Sessions/List.aspx#folderID=%2255a37adc-eaae-4aa6-8a06-ab25015a4ee8%22

Pinker’s syllabus is here
https://stevenpinker.com/files/pinker/files/gen_ed_1066_rationality_syllabus_spring_2020.pdf

Tyler Vigen, “Spurious Correlations,” website with lots of entertaining examples, at http://tylervigen.com/spurious-correlations