

The Perils of Prediction
GESM 160 (4 units) Fall 2015
Tue and Thu 11-12:20, VKC 254

Instructor: Todd A. Brun
Office: EEB 502
Office Hours: Mon 2-4, Thu 3:30-5
Contact Info: tbrun@usc.edu (email)
(213) 740-3503 (Office)

Course Motto: “It’s tough to make predictions, especially about the future.”—Yogi Berra

Course Description

Throughout history, many attempts have been made to forecast the future, by leaders, prophets, fortune-tellers, sages, businessmen, scientists, charlatans and storytellers. The results, taken all in all, have not been impressive. In spite of our best efforts, the future remains fundamentally unpredictable.

In this seminar, we will study quantitative tools for dealing with uncertainty—logic, probability, statistics, and mathematical modeling—and some of the phenomena that make prediction difficult, such as chaos and complexity. We will also look at some specific areas in which people would like to make predictions: weather, economics and politics, technology and social change. This course is aimed at students in the arts and humanities who are not afraid of numbers.

Learning Objectives

Students in this course will gain proficiency in the following areas:

- **Critical Thinking:** Logic and probability. Using Bayesian probabilities to represent uncertainty. The connection between probabilities and statistics. Chaos and complexity, and their effects on predictability.
- **Logical Integrity:** Logical versus plausible reasoning, and common logical fallacies. Paradoxes of probabilistic reasoning. Tetlock’s model of predictive style; foxes versus hedgehogs.
- **Formal Reasoning:** Constructing mathematical models of the world. Making deductions from a formal model, and comparing them to reality.
- **Applications:** Predicting weather versus predicting climate. Attempts to make economic and political predictions, and their limitations. The unpredictability of science and technological advances.

These subjects will be illustrated by readings from a wide variety of sources, both popular and technical, with an emphasis on subjects important to society.

Recommended Preparation: A good knowledge of simple algebra and basic numeracy. Knowledge of calculus is helpful, but not required. Some previous exposure to probabilities and statistics is also useful.

Course Notes

This class will be graded based on the following: participation in class discussions; eight problem sets; two papers; a midterm exam, and a final exam. My lecture notes will be scanned in and made available on Blackboard, along with all assignments and other course content.

Technological Proficiency and Hardware/Software Required

We will make simple use of Mathematica, available through a USC site license. Course content will be distributed through the online Blackboard system.

Description and Assessment of Assignments

The eight problem sets will be on the main quantitative topics of the course: logic and probability, statistics, chaos and complexity, and mathematical models. The two papers will be on topics of the students' choice related to prediction in human society, such as predicting political or economic events, or social or technological change. The exams will be a mix of quantitative and essay-type questions.

Grading Breakdown

| Assignment | Percentage of grade |
|---------------------|---------------------|
| Class participation | 10% |
| Problem sets | 20% |
| Papers | 20% |
| Midterm Exam | 20% |
| Final Exam | 30% |
| TOTAL | 100% |

Additional Policies

Students are encouraged to discuss assignments with each other, but all assignments must be done and submitted individually. Late work will not be accepted unless permission is obtained in advance, and will require a strong justification. Exams cannot be made up except in case of a medical emergency.

Required Readings

Most readings are either excerpted in a course reader or provided in electronic form, but some will be purchased separately.

These will be read in their entirety:

Instructor's Lecture Notes

Love is a Fallacy, Max Shulman

How to Lie With Statistics, Darrell Huff

The Cartoon Guide to Statistics, Larry Gonick

Foundation, Isaac Asimov

Paris in the 20th Century, Jules Verne

The New Atlantis, Francis Bacon

These will be excerpted (typically 1-3 chapters):

Symbolic Logic, Lewis Carroll

Probability: the Logic of Science, E.T. Jaynes

The Signal and the Noise, Nate Silver

Chaos, James Gleick

Chance and Chaos, David Ruelle

Climate: A Very Short Introduction, Mark Maslin

2081, Gerard K. O'Neill

Expert Political Judgment: How Good Is It? How Can We know?, Philip Tetlock

Where's My Jetpack?, Daniel H. Wilson

The Wonderful Future That Never Was, Gregory Benford

The Black Swan, Nassim Nicholas Taleb

The Wealth of Nations, Adam Smith

Complexity: A Guided Tour, Melanie Mitchell

Complexity: A Very Short Introduction, John H. Holland

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* <https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

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* <http://equity.usc.edu> or to the *Department of Public Safety* <http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us>. This is important for the safety of the 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* <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage <http://sarc.usc.edu> describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

Course Schedule: A Weekly Breakdown

| | Topics/Daily Activities | Readings | Due Dates |
|--------------------|--|--|-------------|
| Week 1 | Unpredictability. Logic and probabilities; reasoning with uncertainty. | <i>Symbolic Logic; Love is a Fallacy; Chance and Chaos.</i> | |
| Week 2 | Probability: dice vs. horse races. Subjective probability and the Bayes rule. | <i>Probability.</i> | HW 1 due |
| Week 3 | Predicting the unpredictable. Unexpected events. Coincidences. | <i>The Signal and the Noise; The Black Swan.</i> | HW 2 due |
| Week 4 | Probability and Statistics. Polling and uncertainty. | <i>How to Lie With Statistics; The Cartoon Guide to Statistics.</i> | |
| Week 5 | Expert prediction. Foxes and hedgehogs. | <i>The Black Swan; Expert Political Judgment; The Signal and the Noise.</i> | Paper 1 due |
| Week 6 | Statistical significance. Why do so many studies turn out to be wrong? | <i>Probability; The Cartoon Guide.</i> | |
| Week 7 | Chaos theory. Dynamical systems. The logistic map. | <i>Chaos; Complexity: A Guided Tour.</i> | HW 3 due |
| Week 8 | Predicting weather vs. predicting climate. | <i>Chaos; Climate: A Very Short Introduction.</i> | HW 4 due |
| Week 9 | Midterm Exam. | | |
| Week 10 | Complexity. Systems with many moving parts. | <i>Complexity: A Very Short Introduction.</i> | HW 5 due |
| Week 11 | Building mathematical models. | <i>Complexity: A Very Short Introduction.</i> | HW 6 due |
| Week 12 | Predicting new technology. | <i>New Atlantis; Where's My Jetpack; Wonderful Future; Paris in the 20th Century; 2081.</i> | HW 7 due |
| Week 13 | Modeling the economy. | <i>The Wealth of Nations; The Signal and the Noise.</i> | HW 8 due |
| Week 14 | Predicting political and economic events. | <i>The Black Swan; Expert Political Judgment; Foundation.</i> | |
| Week 15 | Predicting social change. | <i>2081; Foundation; Paris in the 20th Century.</i> | Paper 2 due |
| Exam Period | Final Exam. For the date and time of the final for this class, consult the USC <i>Schedule of Classes</i> at www.usc.edu/soc . | | |