Statistics, Lies and Drunkard's Walks:
The Power and Pitfalls of Probabilistic Reasoning

HON 394, Spring 2018 **Thomas.W.Martin@asu.edu**
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Office Hours: CNTR 140A **Tues 1-3 or by appointment**

Course Description:

It is unanimously agreed that statistics depends somehow on probability. But, as to what probability is and how it is connected with statistics, there has seldom been such complete disagreement and breakdown of communication since the Tower of Babel. Doubtless, much of the disagreement is merely terminological and would disappear under sufficiently sharp analysis.

- Foundations of Statistics by Savage

There are lies, damn lies, and statistics.

- Attributed to Mark Twain (but probably Benjamin Disraeli)

The use and abuse of statistics dominates contemporary life. Never have governments and corporations collected so much information about us. Never have we been more regularly told – now on a daily basis – what the latest studies say about what we should eat, what we should do, and when we should do it. No field would dare to call itself "scientific" without making use of statistics in some way. Yet for all its pervasiveness and undeniable importance, the general public's understanding of statistical reasoning remains confused, and even experts misuse techniques or misinterpret results with disarming frequency.

The aim of this course is to make the student more statistically literate. Statistical literacy can be conceived as a central component of scientific literacy, particularly understanding how evidence correlates to hypotheses. This course presumes no prior exposure to a statistical discipline. Nevertheless, it is designed to be of substantial value to those trained in statistical techniques, by forcing them to think rigorously about the fundamental concepts and problems of the field. We will open with critical reading and discussion of first-rate popular texts (Hand, Mlodinow) as preparation for more scholarly historical/philosophical analyses (such as Hacking). We will finish with a recent bestseller that focuses on a proverbial holy grail of statistics – prediction – written by one of its most prominent practitioners (Silver).

A final but critical theme concerns the presentation of data: specifically, the course is rooted in the view that data presentation is never merely window dressing. Poor presentation can (intentionally or unintentionally) deceive, while good presentation can elucidate complex relationships in a way that might otherwise tax the limitations of the human mind.

Course Objectives:

- To learn foundational principles of probability and statistics, with particular emphasis on their historical origin in the 17th century and maturation in the 19th century
- To gain a greater appreciation of the interplay between scientific concepts and their social contexts and implications
- To learn about common cognitive issues surrounding representation - and misrepresentation - of data
- To learn to use non-technical but powerful packages enabling the organization and presentation of data
- To become statistically literate: i.e., to become better at recognizing good data, good representations, and ultimately making better inferences and predictions

In general, our weekly readings will focus on the foundations/development of statistical concepts. Workshops will focus (loosely speaking) on the psychology of data presentation, particularly on common human biases and the (un)intentional exploitation of those biases.

Course Materials:

Required physical texts (all paperback):
The Taming of Chance by Ian Hacking
The Signal and The Noise by Nate Silver
The Black Swan by Nassim Taleb
The Drunkard's Walk by Leonard Mlodinow

Grading:

***Class Participation (40% of course grade)*.** As upper-level honors students, you are expected to understand the basic dynamics of seminar discussion and participate on a regular basis. When you come to each class session it is assumed you have done the reading, that you bring it to class, and that you are ready to contribute. The course simply cannot work without your full involvement, and your grade will reflect the importance of this component.

Mini-projects (20% of course grade). The second half of each weekly meeting will involve small workshops. Most of these will be completed and turned in during the class session. Occasionally some projects may require more time, but this will be handled on a case-by-case basis.

Final Project (40% of course grade). The final project will be a group project using a specific case study to demonstrate the (mis)use of statistics or statistical reasoning. Some class time will be devoted to brainstorming and getting feedback on potential project ideas. Although students are *not* expected to generate their own data, and presentations are *not* required to be highly technical. They should, however, make good use of the techniques discussed in the course. Group size will be determined based on the size of the class, as well as the nature of the proposed project.

Policies and Procedures:

Attendance*:* If you miss more than one class, your Class Participation grade will be directly affected. Depending on circumstances, more serious sanctions such as forced withdrawal or course failure could result from three or more absences. *You MUST bring the assigned text to class, or you will be marked absent.* Arriving late to class more than twice will result in deductions from your class participation grade.

Class meets each Wednesday from 4:50 PM to 7:35. The general format will be as follows:

4:50 – 6 PM: Discussion
6:00 – 6:15: Break
6:15 – 7:35: Workshop

Due Dates and Late Assignments: Assignments are due by the time stated when given. If you have a documented, valid excuse to turn in an assignment after a deadline (such as serious illness or death in immediate family) you should inform me as soon as possible in writing. Otherwise, NO late assignments will be accepted.

Plagiarism**:** Plagiarism is defined as deliberately passing off someone else's words or ideas as your own: it is theft of intellectual property. In the "real" world, such theft can result in very severe penalties. In the world of this course, it will result in failure of the course, as well as referral to the Student Conduct Committee of the University and possible expulsion from the University. The Barrett Honors College utilizes a plagiarism service that checks a database of over 100,000 student essays and text notes. Besides not being worth the risk, plagiarism completely undermines everything we are trying to accomplish. ***Violators will receive absolutely no sympathy*****.**

The officials ASU policy on Academic Integrity is as follows:

Academic honesty is expected of all students in all examinations, papers, laboratory work, academic transactions and records. The possible sanctions include, but are not limited to, appropriate grade penalties, course failure (indicated on the transcript as a grade of E), course failure due to academic dishonesty (indicated on the transcript as a grade of XE), loss of registration privileges, disqualification and dismissal. For more information, see https://provost.asu.edu/academicintegrity

And our Barrett Statement of Ethics:

The Barrett community is committed to upholding values of academic, professional, and personal honesty of the highest order. We believe that ethical and respectful behavior is one of the most important measures of the worth of an individual and, as such, the overall integrity of our community as a whole.

As you can see, we take these issues seriously all the way from the level of the individual teacher or student, to the Barrett community, all the way to the level of ASU as an institution.

Student Conduct: Students are entitled to receive instruction free from interference by other members of the class. An instructor may withdraw a student from the course when the student's behavior disrupts the educational process per "Instructor Withdrawal of a Student for Disruptive Classroom Behavior"

http://www.asu.edu/aad/manuals/ssm/ssm201-10.html

Appropriate behavior is defined by the instructor and includes keeping course discussion focused on the assigned topics. Students must maintain a cordial atmosphere and use tact in expressing differences of opinion.

The Office of Student Rights and Responsibilities accepts incident reports from students, faculty, staff, or other persons who believe that a student or a student organization may have violated the Student Code of Conduct https://eoss.asu.edu/dos/srr/codeofconduct

Multicultural Statement: Barrett, the Honors College at Arizona State University, is committed to creating a multicultural learning environment, which is broadly defined as a place where human cultural diversity is valued and respected. Barrett courses integrate multicultural and diversity issues in ways that are designed to enhance students' honors experience and promote learning goals. We hope that our students will contribute their unique perspectives to this effort by respecting others' identities and personal life histories and by considering and raising issues related to multiculturalism and diversity as appropriate to individual course content.

Writing Center

The Barrett Writing Center at Polytechnic is relatively small, but the student/tutor ratio is still higher than it is at the Tempe campus. Even as upper level students, it is highly recommended you make use of this resource throughout your honors career. Significantly more information about paper expectations and Writing Center scheduling will be provided for any projects, such as the final project, that will involve a substantial writing component.

Class Schedule

Weekly Schedule Subject to Change

W Jan 10 **Course Introduction**
Workshop: Gapminder w/ Dean Henderson

W Jan 17 **Discussion: *Drunkards's Walk* Ch. 1 - 5**
Workshop: Gapminder (Student Findings)

W Jan 24 **Discussion: *Drunkard's Walk* Ch. 6-10**
Workshop: How To Lie With Statistics

W Jan 31 **Discussion: *Emergence of Probability* Ch. 1 - 9**
Workshop: How To Lie (Student Findings)

W Feb 7 **Discussion: *Theory That Wouldn't Die* (Digital Text)**
Workshop: Bayes Original Text (w/ Dr. Oberle)

W Feb 14 **Discussion: *The Taming of Chance* Ch 1 -7**
Workshop: Cognitive Bias

W Feb 21 **Discussion: *The Black Swan, Part I***
Workshop: How To Tell the Truth (Tufte 1)

W Feb 28 **Discussion: *The Black Swan, Part II***
Workshop: How To Tell the Truth (Student Findings)

Spring Break (March 4 -11)

W Mar 14 **Discussion: *The Signal and the Noise* Ch. 1 - 4**
Workshop: Final Project Brainstorm

W Mar 21 **Discussion: *The Taming of Chance* Ch 8 - 15**
Workshop: Efficient Market Hypothesis

W Mar 28 **Discussion: *The Taming of Chance* Ch 16 - 23**
Workshop: Gray's Disease

W April 4 **Discussion: *The Signal and the Noise* Ch. 5 - 9**
Workshop: Final Project Update

W April 11 **Discussion: *The Signal and the Noise* Ch. 10 - 13**
Workshop: Climate of Skepticism

W April 18 Final Project Presentations

W April 25 **Course Summation**

Written Report Due: May 2