Probability, Paradoxes, and Fishy Statistics
Autumn Semester 2018
ARTSCI 1138.xx

Instructor: Dr. Sinnott
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Prerequisite: none

Class Time: TBA
Credit Hours: 1

Course Description: "There are three kinds of lies: lies, damned lies, and statistics." This sentiment (said by Benjamin Disraeli according to Mark Twain) reflects a common perspective: that statistics are profoundly untrustworthy. However, in the right hands, probability and statistics can be powerful tools for understanding how the world works. Interestingly, even when used correctly, statistical tools can sometimes produce results that seem fishy, but do in fact reflect the truth. For example, a similar trend within two groups can disappear or even change direction when the groups are combined (Simpson's Paradox), or a new diagnostic tool applied to the same group of patients can make it look like everyone's survival has improved (the Will Rogers Effect). In this course, we will cover these and other paradoxes and puzzling effects in probability and statistics.

Course Format And Requirements: The format of this course will be a mix of lecture, group problem solving, and discussion. We will read *The Drunkard's Walk: How Randomness Rules Our Lives*, a book that weaves together history, psychology, and probability, and discusses some of the paradoxes we will cover. There will also be a few additional readings from the literature. All students are expected to do the reading to facilitate lively discussion; in addition, students will be assigned to help lead discussion on certain topics throughout the semester, which will count towards their participation grade. This could involve putting together a few discussion questions, a few slides, or presenting an illustrative example.

There will also be some problems assigned for homework: these will be exercises in probability designed to help students better understand the phenomena we are discussing. There will also be some coding assignments in the statistical software R to help illustrate some of the concepts. The coding assignments will come with a lot of guidance and sample code, and no previous experience with R is expected. Expect approximately 2 problem sets and 2 coding assignments over the course of the semester.

Course attendance policy: Attendance is mandatory. If you must miss a class due to illness or emergency, you must contact the instructor in advance. Absences due to illness may be excused if the student submits a doctor's note. Students are expected to come to class prepared to discuss topics presented in the readings.

Grading: Grading for this course is S/U (Satisfactory/Unsatisfactory) and will be based on class participation, and homework.

Participation – 40% Problem Sets (≈ 2) – 30% Coding Assignments (≈ 2) – 30%

To receive a "Satisfactory" grade, students must achieve an 80% or higher.

Website: The course website will be available at `http://www.carmen.osu.edu`. Check the website periodically for announcements about the class and other class material.

Required Text: *The Drunkard's Walk: How Randomness Rules Our Lives* by Leonard Mlodinow. Pantheon Books, 2008.

R Software: The R (`https://www.r-project.org/`) and RStudio (`https://www.rstudio.com/`) software will be introduced in this course. This is free software that you can download and install on your personal machines.

Academic Misconduct: Please help us to maintain an academic environment of mutual respect, fair treatment, and personal growth. Students are encouraged to work together on problem sets and coding assignments, but all students must submit their own written work IN THEIR OWN WORDS. It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct `http://studentlife.osu.edu/csc/`.

E-mail Correspondence: In order to protect your privacy, all course e-mail correspondence must be done through a valid OSU name.nn account.

Special Accommodations: Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 614-292-3307, `slds@osu.edu`; `slds.osu.edu`.

Diversity: The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

TENTATIVE SCHEDULE

These topics may change slightly depending on holidays and the pace of the course. Chapters below are from the required text, and are listed when assigned (i.e., "Read Ch. 1" listed in Week 1 means it is assigned that week and "due" Week 2).

Week 1	Introduction to Probability	Problem Set 1 Assigned Read Ch. 1
Week 2	More Probability; Randomness; Benford's Law	Problem Set 1 Due Read Ch. 2 & 3
Week 3	Sample Space; Two Daughter Problem; Monty Hall Problem	Coding Assignment 1 Assigned Read Ch. 4
Week 4	Birthday Problem; Coincidences	Coding Assignment 1 Due Read Ch. 5
Week 5	Laws of Large Numbers and Small Numbers	Read Ch. 6
Week 6	Conditional Probabilities and Bayes Theorem	Problem Set 2 Assigned Read Ch. 7
Week 7	Central Limit Theorem	Problem Set 2 Due Read Ch. 8
Week 8	Regression to the Mean	Read Ch. 9 & 10
Week 9	Hot Hand Fallacy	Reading Assigned
Week 10	Simpson's Paradox	Reading Assigned
Week 11	Publication Bias	Coding Assignment 2 Assigned Reading Assigned
Week 12	The Will Rogers Effect	Coding Assignment 2 Due Reading Assigned
Week 13	Fairness in Machine Learning	
Week 14	Correlation & Causation	