

Probability Project

STAT/MATH 360 Prof. Leise

Goal: To delve deeply into a topic of interest by finding and studying an article or part of a book on that topic and then writing a report, which should include some mathematical analysis and/or statistical computations related to probability in some way.

The project report and presentation forms 15% of your course grade, and, more importantly, is your opportunity to learn about something of interest to you. Feel free to propose a topic that is completely different from anything we have discussed; also feel free to choose a project that delves deeply into a topic that we did examine.

Topic suggestions (you are not limited to these; an internet search will yield many topics):

- Examine some of the mathematical theory, for example, the proof to a big theorem like the Law of Large Numbers or Central Limit Theorem
- Take a deeper look at moment-generating functions
- Monte Carlo methods for numerical integration or other computations
- Markov chain theory or applications, including Markov Chain Monte Carlo
- Other types of stochastic processes (branching process, Poisson process)
- Analysis of payoffs in simple games
- An application of probability to economics, finance, gambling, physics, biology, chemistry, social sciences (e.g., work of Daniel Kahneman and Amos Tversky), etc
- History of development of a probability topic or the work of a prominent figure in probability (Cardano, Bernoulli, Gauss, Chebyshev, Khinchin, Kolmogorov, Laplace, Markov, de Moivre, Pascal, etc)
- Modern figure in probability like Persi Diaconis
- See the recent book by Diaconis and Skyrms, *Ten Great Ideas about Chance*, for more topic ideas

Feel free to talk to me at any point about finding sources and what material should be included in the final report.

Timeline:

- Choose a topic by **Tuesday November 6** and email me a proposal of what you want to do (a few sentences describing your proposed project topic and state a potential source of information for your report).
- Final report due **Wednesday December 12**. Please email me your file by midnight.

Report guidelines: The report should be at least 4 pages double-spaced, using Word, LaTeX, R Markdown, Mathematica, or some other appropriate format. The report should include significant mathematics in some way (theoretical or computational), and may also include less technical explanations and relevant historical or scientific background: how a

problem arose, why a method was developed, who was involved in the development of the ideas, historical evolution of ideas, etc.

Sources: You should use at least one source of information beyond your textbook. This source may be a book or scholarly article. You should not rely on a website as a main source of information in most cases (since websites often contain incorrect information), but searching the web may be helpful initially as an idea-generator of interesting topics and for basic information. Searching JSTOR and MathSciNet may also be helpful, in addition to a general Five College library search (start looking for books and articles early in case you need to ask for an interlibrary loan or order an article to be delivered).

Your report should list **all sources** used in researching and writing your report. You may use any standard style to cite them, for example:

Baker, G.L., and Gollub, J.P. *Chaotic Dynamics: An Introduction*, Cambridge University Press, Cambridge, 1990.

Li, T.-y., and Yorke, J., "Period Three Implies Chaos." *American Mathematical Monthly* **82** (1975), 985-992.

There are two purposes in citing your sources: first, to give credit to those who did the work and published it, and second, to enable readers to find these articles or books if they want to read further about that topic.

When you refer to a source of information in the text of your report, cite that source using a standard style, as in the following examples:

One author: How fireflies oscillate in synchrony can be explained using a relatively simple nonlinear system (Strogatz, 1994).

Two authors: Tyson and Novak (2001) discovered a bifurcation that explains the cell cycle.

More than two authors: Tyson et al. (2004) found that something interesting occurred.

If you copy a figure, cite the source in the caption.