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Markov Chain Monte Carlo (MCMC) and Mathematics for Redistricting and Defining and Detecting Gerrymandering

I suggest below to section members for general interest and in light of current redistricting efforts and court cases about gerrymandering following the US Census release. There are some high-level mathematics involved simply in the mathematics required to define gerrymandering, not at all in my skill set.

Secondarily, I provide a suggestion below for sections member considering organizing a contributed or invited paper session or organizing a short course at a future JSM. For reason mentioned below there may be a possibility for expert witness testimony for interested consulting section members, though I speculate there may be a “high bar” for that activity.

WAPO recently published an article about redistricting and “technology” for assessing gerrymandering among other issues.

<https://www.washingtonpost.com/politics/interactive/2022/algorithmic-redistricting/?itid=hp-top-table-main-t-5>

The technology mentioned in the article is “Monte Carlo” simulation. More precisely “Markov Chain Monte Carlo” (MCMC) simulation is used in simulation work for redistricting. And results and assessments arising from the use of MCMC are presented in court – a non-technical description in the WAPO article. And what I understand to be the origin of the term gerrymander and a graphic of the gerrymander map of 1812 for eastern Massachusetts

<https://assets.rebelmouse.io/eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJpbWFnZSI6Imh0dHBzOi8vYXNzZXRxLnJibC5tcy8xODU3ODEwOS9vcmlnaW4uanBnliwiZXhwaXJlc19hdCI6MTY2NzkzOTk5NX0.EnwTDnKY918ctk-1KJVH0HTFuNc3sF3SMBgMBKUjrHg/img.jpg>

Explanation and background to the original gerrymander graphic

<https://bigthink.com/strange-maps/53-ever-been-gerrymandered/>

The article specifically mentions Dr. Moon Duchin a mathematician at Tufts. About 5 or so years ago, Dr. Duchin and her team of about 10 assistants, conducted a short course, at various locations around the country to teach the technical methods, mathematics, statistics and principles for redistricting. I attended the about 5 full day course in San Francisco. That course was offered through the MCGG (Metric Geometry and Gerrymandering Group) redistricting lab <https://mggg.org/>

A few publications by Dr Duchin about the mathematics and metrics and related issues for gerrymandering <https://mggg.org/work>

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One specific claim of the instructors of the course was that attendees completing the entire course would be qualified to give Expert Witness Testimony in court cases about Gerrymandering. Perhaps More importantly one of the course instructors commented that redistricting is not simply limited to the US Senate and house, but may apply in (potentially) simpler situations such as the local school board.

Dr. Duchin main research area is geometric group theory and geometric topology

<https://math.tufts.edu/people/faculty/moon-duchin>

- I commend anyone interested - consider inviting Dr Duchin for a lecture or presentation at a future JSM.

Below are the links /citations embedded in the WAPO article.

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[the 50-State Redistricting Simulations project](#),

https://alarm-redist.github.io/fifty-states/?itid=lk_inline_enhanced-template

Simulated Redistricting

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[the website All About Redistricting](#)

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