Nesting Rules for Political Redistricting: Methods for Sampling Matchings & Triplings

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Description

How do we know when voting districts have been drawn unfairly? Although there's no legally accepted standard for detecting partisan gerrymandering, an approach called ensemble analysis provides useful tools that can inform state and local governments. In ensemble analysis, we mathematically create ensembles of thousands of hypothetical districting plans, and then compare them to real, enacted plans to decide whether an enacted plan is an outlier. My senior thesis deals with particular sets of laws that apply to the Oregon and Wisconsin state Senates, and how we can translate those laws into the language of mathematics. Specifically, I consider methods for uniformly sampling perfect matchings and perfect triplings on dual graphs of state House districting plans, which correspond to districting laws that require nesting, meaning that each Senate district must comprise two or three entire House districts. In my expository senior essay, which focuses on graph theoretic approaches to this political problem, I consider several Markov chains on the state space of dual graphs, the FKT algorithm for perfect matchings, and ensemble analysis interpretation, among other topics.