

Potential Student Research Projects

Pickleball Analytics and Tournament Design

Keywords: Sports Analytics, Pickleball, Tournament Design, Data Analysis

Project Description: Racket sports have often lagged behind other sports in terms of incorporating large-scale analytics models. There are opportunities for student projects about pickleball, an increasingly popular recreational sport, focusing on analyzing aggregate properties of professional matches using the pklmart database and determining the properties of tournament and recreational play formats. Here are some potential starting points:

- Analyzing shot distributions as a function of court position and shot type.
- Determining game and point winning probabilities as a function of serving rates and player ratings
- Analyzing the fairness properties of King of the Court models compared to round robin or elimination brackets
- Developing complete brackets for mixed partner mixed doubles round robin formats

I have preliminary projects and data along these lines, as well as query access to the pklmart database, and some examples of this data are displayed in Figure 1 below. No prior knowledge of pickleball is necessary ☺

Recommended Student Background and Readings: For some of these projects Math 220 would make for good preparation, as well as programming experience or an interest in developing programming/data skills. Depending on student interest this background would not be required. The following papers might make for good introductory reading: [Why Tennis is still not ready for Moneyball](#) and [Does the first-serving team have a structural advantage in pickleball?](#). Some webpages and widgets exploring these ideas can be found [here](#), [here](#), and [here](#). There will be opportunities to work with empirical data and collaborate with domain scientists, including statistics and sports management faculty.

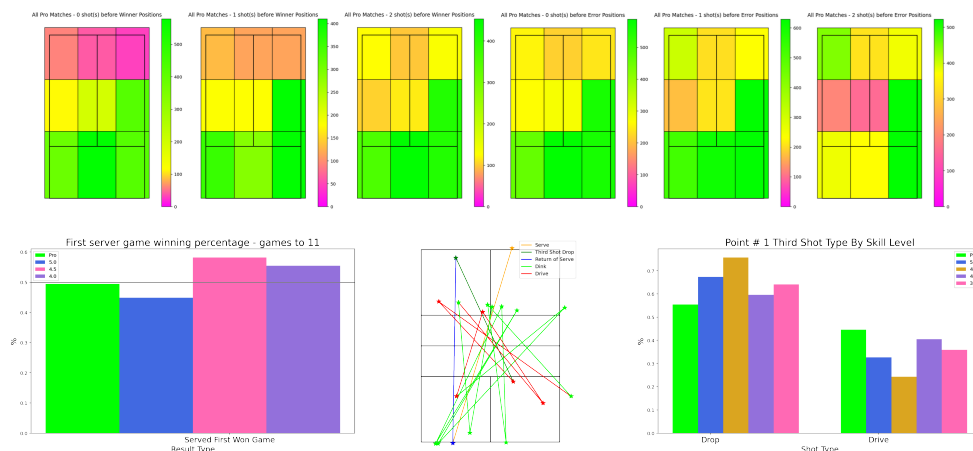


Figure 1: The top row shows the relative frequency by court position of winners and errors across all pro matches in the database. The left panel on the bottom shows the first server win percentages, validating the theoretical work in a previous paper, while the central panel shows the ball positions of a single point and the right panel shows a breakdown of third shot types by skill level.

Detecting and Analyzing Political Gerrymandering

Keywords: Political Redistricting, Gerrymandering, Markov Chains, Geospatial Data

Project Description: Political redistricting is the process of drawing legislative districts for US Congress and state legislatures. In the past decade, mathematical techniques have become increasingly important for determining when *gerrymandering*, the drawing of district lines for improper purposes to (dis)favor one group or party, has occurred. In particular, the *ensemble method* of constructing a large number of algorithmically-generated plans that don't incorporate partisan data to construct a 'neutral' baseline for comparison is a relatively new approach that has been used in academic work, court cases, and public policy reform efforts. This is a great area for student projects, particularly if the student has a particular state they would like to study. Starting points could include:

- Studying the partisan consequences of legislation around traditional criteria
- Modeling how ranked choice voting interacts with voting districts
- Studying how vote models, including polls and predictions impact the evaluation of districts
- Analyzing the interaction between quantitative methods and line drawing processes, including iterative approaches and game theory
- Evaluating tradeoffs between redistricting metrics and their interaction with political geography.

Additional example of starting points for student projects in this area can be found [here](#).

Recommended Student Background and Readings: There are no specific course requirements for students interested in working on this topic but it does require an interest in interdisciplinary work and American democracy. Some Python or R programming experience is a plus but not required. A good starting point for reading about this area is the book *Political Geometry*¹. This [link](#) also contains additional background reading and references, as well as pointers to computational resources and other learning material.

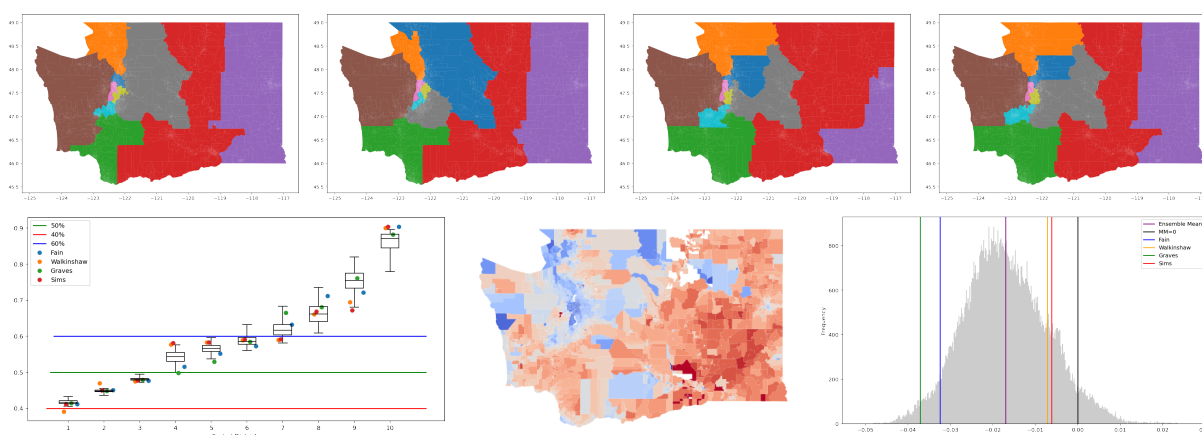


Figure 2: The top row shows the four maps proposed by the WA commission this cycle while the bottom row shows some partisan statistics for these maps, as well as the vote distribution in recent WA elections.

¹link is to free online copy - chapters 16 and 17 are a good starting point for reading about the algorithmic aspects, while Chapter 5 is a good introduction to the idea of political geography