Note: Since our project is in the form of a StoryMap, here is the link to view our full project.

The fall semester of 2022, we took a class with Professor Sarah Cannon at Claremont McKenna College titled "Advanced Topics in Mathematics: Math of Political Districting." In the class, which was a blend of math, coding, and politics, we studied the history of political redistricting in the United States and the current mathematical and computational efforts developed to identify a gerrymandered district plan.

For our final project, we chose to examine the little-known phenomenon of "prison gerrymandering," also known as "prison malapportionment." When drawing political districts for any level of government, thirty-four states count incarcerated people where they are incarcerated and not at their former place of residence. This creates a representation problem because areas with prisons are given a boost in population, despite the incarcerated people, in most cases, not being able to vote.

The issue disproportionately affects low-income communities of color, who are incarcerated at rates higher than their population share. In many states, prisons are located in rural, white areas. These areas are then overrepresented in our political system, while low-income communities of color with higher rates of incarceration are underrepresented.

However, we couldn't find a detailed analysis of the precise effects of prison gerrymandering, so we were left with several questions that then animated our project. How much does prison gerrymandering affect political representation at the state level? Could we quantify its effects?

We focused on the two states where we each grew up, Arizona and Hawaii. Both are guilty of prison gerrymandering when drawing their political districts.

To answer our research questions, we used code to generate two different ensembles, or groups, of thousands of possible redistricting plans in each state. One ensemble was made using current census population data where incarcerated people are counted at the location where they are incarcerated. The other ensemble generated districting plans after re-allocating incarcerated people to their last known residences. We then compared several key variables (such as the amount of districts with a majority of Latino people (AZ) or Native Hawaiians (HI)) to examine prison gerrymandering's effects on representation.

We couldn't have done our project without Jeanine Finn, a data and statistics librarian at the Claremont Colleges Library. Early in the semester, Jeanine visited our class to give a workshop on how to use Geographic Information System (GIS). She introduced us to the US Census website and showed us how to find information on race, age, and citizen voting age population, among other characteristics.

Since US Census data does not contain any geographic information that links the census area to any physical location, Jeanine taught us how to combine US Census population data with shapefiles, which contain this geographic information. This would prove to be a crucial skill for our project, as we had access to data about the incarcerated population in census areas, but not to the geographic location. Because of Jeanine's workshop, we were able to use GIS to join these two different data sets into a unified data set for us to analyze.

In addition to providing us access to an ArcGIS account, the library (through Jeanine) also gave us more free credits to use on our accounts when we had made so many maps on ArcGIS that we reached the credit limit. Furthermore, our final project is presented in the form of a StoryMap, which is an interactive website made through ArcGIS. We chose to make a StoryMap because it would allow us to showcase the mapping and data analysis we did in our project.

Although the final results of our research mostly involved analyzing graphs generated with Python, the process of mapping was crucial to our project, as it allowed us to visualize the results and catch errors. For example, when our Hawaii code wasn't working, we used the mapping techniques Jeanine taught us to show the different districts in Hawaii. Suddenly, we realized that some of the districts we had generated in Hawaii weren't connected because the state is made up of many islands. This was an issue for the specific function we were using to draw out redistricting plans. Because of our newly learned abilities with ArcGIS, we were able to fix the issue.

Using mathematics to address problems in political redistricting is a relatively new topic. Many of the foundational sources we read were written in the last fifteen years, such as "Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures," (2012) and "Discrete Geometry for Electoral Geography" (2018). We were able to access these articles through the library.

The relative newness of using mathematical approaches for political districting was challenging at first. However, by relying on unconventional sources, we were able to piece together disparate research to fit our unique research goals. The part of our project that involved drawing as many majority-minority districts as we could was inspired by a CMC alum's senior thesis, which we were able to access through Scholarship@Claremont, a website run by the library.

This was one of the most exciting parts of our examination of prison gerrymandering—the dearth of research, although at first intimidating, meant that we were doing our own original work. We became confident in our ability to work with popular and scholarly sources, pulling what we needed from each and making it fit into our own project.

The programming techniques were also new to us. Neither of us came into the class with much coding or any GIS experience. The most important learning experience wasn't necessarily the specific lines of code we learned how to write, or the GIS techniques that we used to merge different files. Instead, it was the experience we gained in troubleshooting programming issues. We learned strategies and patience that will help us beyond this project.

Throughout this experience, we learned to take advantage of library resources, explore a relatively new and undocumented field of research, and resolve research and programming issues as they arose. We are so grateful to the library for helping us with our research.