**Oklahoma State University**

**Operations Research Semester Project:**

**Redistricting the state of Arkansas**

**The Matrices:**

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**Executive Summary**

Redistricting is an incredibly important topic. This practice ensures that our society is able to continue to operate on democratic terms. Redistricting allows for the voting power of our citizens to remain relevant and powerful in an ever-expanding nation. Our report will focus on redistricting the state of Arkansas by utilizing a method known as the Minimum Cut Edge.

We began our project by listing the federal and state criteria that we would need to keep in mind as we redistricted our state. We then built an integer program that would utilize our criteria and split the state into 4 districts. By dividing the total population of Arkansas in 4, we were able to determine that our average for each district would need to be around 750,000 people. Our deviation after coding this problem was 0.28% which is well within the criteria imposed at both the federal and state level.

**Introduction**

In the United States, a census is taken every 10 years to ensure records are kept up to date. This census is then used to determine whether redistricting should occur.

Redistricting as a term is used to describe when an area of smaller counties is grouped together in a larger body. This process is thought to help minimize or even eliminate bias in locations or population demographics. There can be several criteria that regulate how the process is done, at both the level of the federal and state government. Because of the number of regulations, and the vast amounts of data required for this task, it can be a very complex operation to redistrict a state. Thankfully, the world of optimization software has greatly simplified the task and in this project, we utilized a popular optimization technique known as the Minimum Cut edges.

**Redistricting Criteria.**

**Federal Criteria**

* Districts must be as close in population as is possible

When conducting congressional redistricting, the Apportionment Clause of Article 1, Section 2 of the U.S. Constitution has been interpreted by the Supreme Courts to mean that all districts must be as close to equal in population as is practical. This means that in practice, districts will often be equal in population.

* Redistricting maps must not intentionally discriminate based on race
* Section 2 of the voting Rights Act of 1964 expressly prohibits states from adopting redistricting plans that either intentionally or inadvertently discriminate on the basis of race as these plans diminish the voting power of minorities.

**Arkansas criteria**

* Arkansas does not require any redistricting criteria other than those specified by the federal government.

**Problem Statement**

Team Matrices will redistrict the state of Arkansas according to state and federal criteria by utilizing the Minimum Cut Edges technique.

**OR Model:**

|  |  |
| --- | --- |
| **Parameters:** | j = district  i = county  Xij = the district after it has been assigned correctly  Rij = {0, 1} |
| **Minimize** cut edges | Min |
| **S.T:** |  |
| Each district must have similar or equal population amounts |  |
| Each county must be assigned to a district |  |
| Each district must have a population deviation within 1% |  |
| Binary | Rij = {0, 1} |
| Each district should have one root |  |
| If **i** isn’t assigned to **j,** then it can’t be its root | , |

**Our Map and Plan**

[**https://districtr.org/plan/183457**](https://districtr.org/plan/183457)

**Github**

[**https://github.com/zacmhall10/OR\_Final\_Project**](https://github.com/zacmhall10/OR_Final_Project)

**Experiments**

This was written in Gourbi and Jupyter Notebook and coded in python. We used a laptop which contains 16 GB of RAM, with this processor: 11th gen Intel® Core™ i7-1165G7 @2.80 GHz.

**Evaluation of plan**

We used minimum cutting edges for the district plan, and we got the maximum population deviation of 0.28%. This process follows the federal and state criteria.

**Conclusion**

The United States has several legal requirements, and one of the requirements is that district should be as close to equal in population as possible. The goal of the federal and state criteria is promoting fairness and equality. The population of each Arkansas district is around 750,000 people.

**References**

GitHub:<https://github.com/logandavis2518/IEM40132020RedistrictingProject/blob/main/Arkansas%20Min%20Cut%20Edges%20.ipynb>

Dr. Buchanans code: <https://github.com/AustinLBuchanan/Districting-Examples-2020/blob/main/D3-Min-Cut-Edges-with-Contiguity.ipynb>