THE IMPACT OF COMPETITIVE CONGRESSIONAL DISTRICTS ON COMPACTNESS AND POLITICAL SUBDIVISION SPLITS IN COLORADO

by

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2020
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Date April 18, 2020
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ABSTRACT

Colorado voters approved Amendment Y to the state constitution in November 2018. This amendment calls for competitive congressional districts in Colorado. The problem is that creating competitive districts conflicts with other districting principles. The research question is what impact will drawing competitive congressional districts have on measures of compactness and preserving political subdivisions. A quantitative-descriptive research design was employed to evaluate this impact by constructing two experimental competitive maps that prioritize preserving political subdivisions and compactness, in turn. The resulting maps were evaluated for competitiveness, preserving political subdivisions, and compactness in addition to comparisons to each other and the existing congressional district map. The major finding is that competitive congressional districts are possible but there are tradeoffs associated with creating them. The competitive map honoring political subdivisions increased the number of competitive districts over the existing map, but compactness was mediocre and fewer competitive districts were created than the map prioritizing compactness. The competitive map prioritizing compactness over political subdivisions resulted in the most competitive districts but split the most counties. The main conclusion is that competitive congressional districts will require the redistricting commission to commit to that goal and make decisions about acceptable tradeoffs.
ACKNOWLEDGEMENTS

Few projects of this length and complexity are the result of individual effort. I am grateful to the people who helped along the way. I want to thank my thesis advisor, Dr. Rebecca Theobald, who embraced this project from its inception and provided tireless encouragement toward its completion. I also want to thank my graduate committee members, Dr. Diep Dao and Dr. John Harner. Dr. Dao provided guidance in the use of geographic information systems (GIS) for this research. Dr. Harner helped me fine-tune my topic by offering insightful critiques of earlier approaches. I give my heartfelt gratitude to each committee member.

I want to thank the following individuals from the El Paso County Clerk and Recorder’s Office for sharing important information early in the project and for providing an internship opportunity to learn even more about GIS and elections: Chuck Broerman, El Paso County Clerk and Recorder; Mary Bartelson, Operations Director; Angie Leath, Elections Director; Karl Nordstrom, Information Systems; and Janice Littlefield, GIS. Janice introduced me to new GIS techniques and provided crucial information that both I and a Colorado College research group needed to complete our respective projects.

I also want to thank Dr. Beth Malmskog and Haley Colgate at Colorado College for collaborating and sharing information with me along with Todd Bleess from the Colorado State Demography Office. Todd’s data saved weeks of manual data entry.

Finally, I want to thank my wife Jeannette and my son Koen for their undying love and support throughout this endeavor. This research would not have been possible without them being awesome in the ways that they are routinely awesome. I hope that I can give back all the time this research took me away from them.
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CHAPTER I
INTRODUCTION

Purpose

Colorado voters approved Amendment Y to the state constitution in November 2018. This Amendment specifies that partisan gerrymandering of district boundaries “must end” and establishes an independent redistricting commission to accomplish that goal (Senate Concurrent Resolution 18-004, § 44.3). Amendment Y also establishes a new redistricting principle for the state, making congressional districts competitive. As one of only four states to implement competition as a districting principle, the redistricting commission in Colorado will be charting relatively new territory. One problem with the new competitive criterion is that it conflicts with other districting principles. For example, drawing competitive districts will require a more balanced number of partisan voters from each of the two major parties. Acquiring this balance will require district boundaries to be adjusted such that principles like compactness or keeping counties intact may be impacted. Many of the redistricting criteria are mandatory and will be implemented before attempting to make districts competitive, but compactness and preserving political subdivisions are criteria that are met as able. This language of meeting some criteria as able comes directly from the state constitution which directs certain actions in redistricting and others as able afterward. The research question for this project examines what impact drawing competitive congressional districts will have on measures of compactness and preserving political subdivisions. This research aims to assist the Colorado redistricting commission members by reviewing the relevant literature, describing existing demographic and partisan voting patterns that influence
competitive district construction, and evaluating the impact of making competitive districts on the criteria to preserve political subdivisions and make districts compact.

**Background**

There are 435 congressional seats in the United States House of Representatives, divided among the various states according to population. The mandate for this is in art. I, § 2, of the Constitution (U.S. Const.). How those seats are divided among the various states is called apportionment. This need to accurately allocate congressional seats is the constitutional foundation for the decennial census count (U.S. Census Bureau, n.d.-b). The census count takes place every 10 years and reapportionment follows as population changes dictate. Apportionment is calculated by the U.S. Census Bureau using the Method of Equal Proportions (U.S. Census Bureau, n.d.-a). The procedure first assigns one congressional seat to each state and then subsequent seats based on a state’s priority number and population. This process determines the number of representatives each state will have in the House of Representatives.

Following apportionment, it is up to each individual state to draw congressional district boundaries. The location of district boundaries is important because they exert an influence on election outcomes depending on who is captured within a district or excluded from it. People with similar political preferences are not uniformly distributed over the landscape. Political partisans may be spread out or clustered (Taylor & Johnston, 2015). District boundaries can either unite or divide people with like-minded political views. The United States employs a single seat congressional district system in which the winner takes all. This means that in a hypothetical two-party race the winner needs 50% plus one vote. This system makes district boundary locations important for how they
include or exclude voters (Taylor & Johnston, 2015). How and where those lines are drawn has been, and continues to be, controlled by individual state legislatures.

The Colorado Constitution outlines criteria to follow in constructing congressional district boundaries. In November 2018, Colorado voters approved Amendment Y to the state constitution which embraces many long-standing districting principles but deviates with regard to protecting incumbents and preserving district cores. There is no requirement to protect district cores and incumbent protection is prohibited. In addition, Amendment Y calls for competitive districts to be drawn as able and creates a redistricting commission charged with combating gerrymandering. These criteria, with the noted exceptions, are in line with common redistricting practices known as “traditional districting principles” (National Conference of State Legislatures, 2009, p. 105). Table 1 compares Colorado’s districting criteria after Amendment Y with traditional districting principles outlined by the National Conference of State Legislatures (2009) (Senate Concurrent Resolution 18-004, § 44.3). Population equality between districts, while not normally listed with TDPs, is a constitutional requirement for redistricting and is included in Table 1 for comparison.
Table 1

*Traditional Districting Principles vs. Colorado Districting Principles*

<table>
<thead>
<tr>
<th>Traditional Districting Principle</th>
<th>Colorado Districting Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population equality</td>
<td>Same</td>
</tr>
<tr>
<td>Contiguity</td>
<td>Same</td>
</tr>
<tr>
<td>Compactness</td>
<td>Same</td>
</tr>
<tr>
<td>Preserve political subdivisions</td>
<td>Same</td>
</tr>
<tr>
<td>Voting Rights Act compliance</td>
<td>Same</td>
</tr>
<tr>
<td>Communities of interest</td>
<td>Same</td>
</tr>
<tr>
<td>Incumbent protection</td>
<td>Prohibited</td>
</tr>
<tr>
<td>Preserve prior district cores</td>
<td>Not required</td>
</tr>
<tr>
<td></td>
<td><strong>Draw competitive districts</strong></td>
</tr>
</tbody>
</table>

*Note.* Colorado districting principles that differ from traditional districting principles are in boldface.

**Why Geographers**

Due to the inherently geographic nature of drawing district boundaries on maps, geographers are well qualified to undertake the task. As Webster (2013) writes in his review of redistricting criteria, redistricting “is both implicitly political and geographic, lending itself to scholarly work by political geographers” (p. 4). Political geographers examine three main areas in the study of electoral geography. They are concerned with the “geography of voting (mapping and visualizing votes), geographic influences on voting (the effect of place on political preferences and behavior), and the geography of representation (the analysis of electoral systems)” (Forest, 2018, p. 1). These can be
summed up as an examination and mapping of voting patterns, an analysis of why those patterns are located where they are, and what influence the underlying electoral system has on election outcomes.

**Early Electoral Geography**

The earliest electoral geographers employed mostly visual analysis of maps in an attempt to answer questions that will be familiar to the modern reader. “What is the spatial pattern of a vote, and what explains such patterns” (Forest, 2018, p. 2)? Was there a geographic influence of place on voting behavior? Due to limited mapping and analysis technology, early electoral geography focused on simply identifying spatial patterns on a hand-made map. Answers to questions about what caused those patterns was often conjecture as statistical techniques for mapping were not yet available (Forest, 2018). Modern electoral geography attempts to answer those same questions, but now computer technology along with well-developed statistical techniques help identify and characterize spatial patterns.

**Voting and Geography**

Early electoral geographers also wondered why people from different geographic areas voted differently (Forest, 2018). Was geography itself a factor? Electoral geographers today believe that spatial voting patterns are the result of two broad effects, compositional and contextual (Forest, 2018). Composition effects refer to how the electorate’s characteristics vary across space and that who makes up a particular segment influences the observed patterns. Contextual effects refer to social environments or networks that may influence political preferences apart from the voter’s characteristics. It is a challenge for electoral geographers to distinguish between the two as voting patterns
can be mapped and analyzed but causality cannot be definitively established. Without detailed survey data, it is impossible to know if an urban Coloradoan’s Democratic vote is due to their sum characteristics as an urban dweller (compositional effect) or due to social influences relating to a particular issue (contextual effect). This conflict between compositional and contextual explanations of observed voting patterns has not been resolved. Individual demographic characteristics such as career, socioeconomic status, education level, age, gender, etc. that make up the compositional effect seem to explain a great deal about voting behavior. However, contextual factors within individual households may lead to voting behavior at odds with what compositional characteristics might suggest (Forest, 2018). Geographic influences on voting, therefore, are more difficult to pin down than a simple examination of an election outcome map might suggest.

**Representation and Geography**

The geography of representation refers to how the electoral system operates. The United States employs a single member representative for a given geographic area using a “first-past-the-post” (FPTP) election system (Forest, 2018, p. 8). These winner take all electoral outcomes are heavily influenced by the spatial distribution of partisan voters because votes are cast for a candidate in a specific geographic area (Forest, 2018; Taylor & Johnston, 2015). A different distribution of partisan voters or, specifically to the purpose of this research, a different set of district boundaries encompassing different groups of voters can lead to very different election outcomes. Political partisans can take advantage of this knowledge and craft district boundaries that produce election results
most favorable to their party. This is known commonly as gerrymandering, which is the manipulation of district boundaries for the purpose of partisan political advantage.

In a FPTP system where a candidate can win by a single vote, elections rarely result in proportionality where the number of seats won by a party is proportional to the number of votes cast for that party. This fact has led electoral geographers to examine the relationship between votes cast and seats won. The seats to votes curve describes that relationship and shows how votes cast translate into seats won under various electoral systems (Tuft, 1973). The idea that a fair system should produce election results where the number of seats won is roughly proportional to the number of votes cast is behind much of the reform efforts throughout the country aimed at curbing gerrymandering, including Colorado’s Amendment Y.

This research will employ two of the three approaches to electoral geography. It will examine and map voting patterns in Colorado in an effort to first understand where partisan voters are located. The influence of the underlying electoral system on election outcomes will be addressed by examining district boundaries and who is included or excluded in relation to partisan voting patterns. The third approach of determining why patterns are located where they are is beyond the scope of this research.

As the history of electoral geography suggests, district boundaries influence election outcomes due to the geographic nature of representation in the United States, FPTP system, and by what groups are included or excluded by boundary lines. Unfortunately, geographic knowledge and skills are no longer the sole factors involved in successfully constructing district lines on a map. The legal profession has claimed a sizable spot at the table due to inevitable legal challenges that follow many redistricting
efforts. Legal challenges are raised on both maps that aggressively seek partisan
advantage (gerrymandering) and many that do not. As such, it is prudent to provide a
legal synopsis at the outset of this discussion.
CHAPTER II
LITERATURE REVIEW

Significant Supreme Court Cases Relating to Redistricting

The National Conference of State Legislatures (2019) maintains a list of the most significant Supreme Court cases relating to redistricting. The list is divided into four categories based on what the case is related to: population, commissions, race and partisanship. The category related to commissions contains a single case, *Arizona State Legislature v. Arizona Independent Redistricting Commission* (2015), which found that the Constitution’s Election Clause does not preclude the creation of independent commissions by ballot initiative to accomplish redistricting in place of state legislatures (National Conference of State Legislatures, 2019a). This means that, although the Constitution calls for state legislatures to conduct election processes, ballot initiatives that establish commissions to accomplish redistricting are permitted. Eight states currently have commissions with the primary duty to draw congressional district boundaries, six employ commissions in an advisory role, and two use a commission as a backup in case the state legislature is deadlocked (National Conference of State Legislatures, 2019b). The remaining Court case categories have a much richer legal history which governs the redistricting process today. Tables with a brief synopsis of each category are included following the discussion of each to provide a quick reference.

Cases Relating to Population

Cases relating to population are some of the most cited cases in the redistricting literature. *Baker v. Carr* (1962) established the precedent that state legislative apportionment and redistricting plans are justiciable by federal courts. What was once the
exclusive purview of state legislatures would now be open to jurisprudence by federal courts (Taylor & Johnston, 2015). Two cases followed Baker in 1964 that called for equal, or nearly equal, population between districts. Wesberry v. Sanders (1964) added congressional redistricting plans to those that were justiciable by federal courts and specified that they contain nearly equal populations—one person’s vote should be worth as much as another’s. Reynolds v. Sims (1964) was decided soon after Wesberry with a ruling that each house of a state’s bicameral legislature be apportioned based on population and districts should contain nearly equal populations. The overarching issue in these early population equality cases was the disenfranchisement of minority voters from the political process. Minority votes were diminished in importance by creating districts, or refusing to reapportion them, so that district populations were very unequal. This resulted in minority votes being worth less than white votes since fewer votes were required for white voters to elect a candidate of choice than for minority voters to do the same. Between Baker, Wesberry and Reynolds, a one person, one vote principle was established for state legislative and congressional districts that addressed this issue of vote diminution.

The next set of cases on population fine-tuned how, exactly, that population equality would be achieved. Gaffney v. Cummings (1973) upheld state legislative redistricting plans with a nearly 8% deviation for the House. This less than perfect population equality ruling was the origin of the often-cited 10% deviation standard—that districts containing population within 10% of other districts are constitutional. It should be noted that this 10% deviation from population equality is not expressly endorsed by the Supreme Court as a standard and most redistricting efforts come much closer to
perfect equality in order to avoid legal challenges (National Conference of State Legislatures, 2009).

The practice of striving for perfect population equality was enshrined 10 years later in *Karcher v. Daggett* (1983) which called for mathematical equality of congressional districts unless a compelling state objective dictates otherwise. Any deviation from mathematical equality should be expressly justified by the state. This was the origin of perfectly equal congressional districts which, as will be discussed later, necessitates violating other districting principles. *Evenwel v. Abbott* (2016) adds clarity to the equal population requirement by specifying that total population is an acceptable metric to apportion district populations. Without this specification, state legislators could choose to use total citizens or total voters in order to manipulate district populations in ways that they deem advantageous to themselves or their party. This standardization allows for districts everywhere to be constructed from the same population metric. *Evenwel* stipulates that total population be used to divide states into equal population districts to comply with the one person, one vote standard established in previous Court cases. Table 2 provides a summary of cases related to population.
Table 2

*Significant Supreme Court Cases Relating to Population*

<table>
<thead>
<tr>
<th>Year</th>
<th>Case</th>
<th>Significance</th>
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<tr>
<td>1962</td>
<td><em>Baker v. Carr</em></td>
<td>State legislative apportionment and redistricting plans are justiciable by federal courts—unequal representation violates the Fourteenth Amendment Equal Protection Clause</td>
</tr>
<tr>
<td>1964</td>
<td><em>Wesberry v. Sanders</em></td>
<td>Congressional redistricting plans are justiciable by federal courts and must contain nearly equal populations—one person’s vote should be worth as much as another’s</td>
</tr>
<tr>
<td>1964</td>
<td><em>Reynolds v. Sims</em></td>
<td>Each house of a state’s bicameral legislature must be apportioned based on population and districts should contain nearly equal populations—one person, one vote principle</td>
</tr>
<tr>
<td>1973</td>
<td><em>Gaffney v. Cummings</em></td>
<td>State legislative redistricting plans with less than perfect population equality (7.83% for House) were upheld—origin of 10% deviation from perfect equality benchmark (<em>Gaffney v. Cummings</em> appears again in cases relating to partisanship)</td>
</tr>
<tr>
<td>1983</td>
<td><em>Karcher v. Daggett</em></td>
<td>Mathematical equality of congressional districts is required unless compelling state objective is justified—origin of perfectly equal population congressional districts</td>
</tr>
<tr>
<td>2016</td>
<td><em>Evenwel v. Abbott</em></td>
<td>Total population is acceptable metric for determining district population to comply with one person, one vote</td>
</tr>
</tbody>
</table>

While the previous Supreme Court cases fall into the category of population cases according to the National Conference of State Legislatures, they were often related to race. Specifically, states were racially segregating parts of the population through malapportionment. As such, the cases were decided on grounds of population equality even though racial discrimination was quite often the underlying factor. The Voting
Rights Act of 1965 addressed racial voting discrimination directly and is an appropriate place to start in order to understand cases related to race.

**Voting Rights Act of 1965**

The Voting Rights Act of 1965 may be seen as a supplement to the Fifteenth Amendment which gave African-American males the right to vote. In defiance of the Fifteenth Amendment, poll taxes, literacy tests, grandfather clauses and similar discriminatory methods were employed in various parts of the country to deny voting rights to minority populations. The Voting Rights Act of 1965 sought to remedy this by establishing that voting rights could not be infringed on the basis of skin color or race.

Voting discrimination in all states is outlawed by § 2 of the Act (Altman & McDonald, 2018). Which states are subject to preclearance requirements in §5 of the Act and what criteria is used in that determination is identified in § 4 (National Conference of State Legislatures, 2014). Certain jurisdictions are required by § 5 to obtain permission from the federal government prior to changing voting rules or procedures in order to determine whether or not the proposed change “reduces minority representation from the previous plan” (Altman & McDonald, 2012, p. 1191). The Supreme Court cases that follow address various aspects of the Voting Rights Act and guide the redistricting process.

_Thornburg v. Gingles_ (1986) clarifies when § 2 of the Voting Rights Act requires the creation of a majority-minority district. A majority-minority district is one where a majority of the population of the district is composed of ethnic or racial minorities. It is created for the purpose of providing representation for that racial or ethnic minority by ensuring that they make up a majority of the population, hence the name majority-minority district. The three-pronged Gingles test provides for the creation of a majority-
minority district when the following three criteria can be shown. First, the minority group must be populous enough and compact enough to make up a majority in the created district; second, the minority group must vote similarly enough to represent a cohesive force; finally, it must be shown that the non-minority population votes as a group to routinely defeat the minority group’s desired candidate (Kosterlitz, 1987). Gingles established that the ability of a minority group to elect a representative of their choice was, in part, what § 2 of the Voting Rights Act sought to guarantee. The three-pronged test shows that a minority group large enough and cohesive enough politically to elect a candidate of its choice may have a need for its own district. This is particularly true if a determined majority, voting together in opposition, can routinely deny the minority group’s desired outcome. Bartlett v. Strickland (2009) refined these criteria by adding that the minority group must also make up a majority of the voting-age population. This addition further points to the outcome orientation of Gingles. If voting-age minority population makes up a majority in a district, the minority group’s desired candidate will likely win. This ability to elect a candidate of choice justifies creation of a majority-minority district.

**Cases Relating to Race**

The next set of cases related to race established a set of principles that the Court would use as a gauge of intent. Shaw v. Reno (1993) was the first time the Supreme Court referenced traditional districting principles (TDPs) (Altman, 1998b; Webster, 2013). The Court found that a racial gerrymander existed because no other purpose could be found for the irregularly shaped district other than a desire to group minority voters together and thus dilute their voting strength (Shaw v. Reno, 1993). Citing TDPs as routinely followed
redistricting practices, the Court found that lack of effort to employ them was evidence that racial gerrymandering was the intent. Aside from establishing that TDPs should explain district shapes, *Shaw* also specified that race cannot be the overarching factor in district construction. *Miller v. Johnson* (1995) added to *Shaw* by stating that race may be accounted for but may not be the predominant criterion (Altman, 1998, Nichol, 2001). *Miller* also further solidified the Court’s use of TDPs as a measure of intent. *Bush v. Vera* (1996) confirmed this, citing lack of adherence to TDPs, especially compactness, in finding that race was the predominant factor involved in a Texas redistricting plan. As such, three of Texas’ districts were struck down as racial gerrymanders. *Bush* also established that partisan gerrymandering can become racial gerrymandering if race is used as a surrogate for party affiliation (National Conference of State Legislatures, 2019a). These cases established that racial gerrymandering was unacceptable and that following TDPs was one way to avoid it and justify district boundaries.

*Shelby County v. Holder* (2013) changed the character of the Voting Rights Act of 1965. Citing forty-year-old data and conditions that had changed significantly since passage of the Act, the Court ruled that § 4(b) of the Voting Rights Act was no longer constitutional (Georgetown Law Library, n.d.; National Conference of State Legislatures, 2019a). Recall that § 4 provided the formula for determining which jurisdictions were subject to § 5 of the Act. With § 4 unconstitutional, § 5 is no longer applicable to any jurisdiction in the country (National Conference of State Legislatures, 2019a). No state is required to seek preclearance prior to changing voting rules or procedures and several of those previously covered under § 5 have moved to enact stricter voting laws (Brennan Center for Justice, n.d.; Georgetown Law Library, n.d.).
The next two cases either clarified or reaffirmed principles already in place. In *Alabama Legislative Black Caucus v. Alabama* (2015) the Court specified that state-wide racial gerrymandering effects were not the correct standard. Rather, district-by-district racial gerrymandering claims have been the standard since *Shaw* (National Conference of State Legislatures, 2019a). The Court also clarified the equal population standard, citing it as a constitutional requirement rather than simply one of several factors to consider (National Conference of State Legislatures, 2019a). This was in response to the redistricting body attempting to cite an equal population goal as evidence that race was not a predominant consideration. The ruling made clear that equal population must be attained along with other criteria, not in place of it. The Court also specified that the purpose of minority representation is the ability to elect a candidate of choice, not to maintain equivalent population percentages (National Conference of State Legislatures, 2019a). *Cooper v. Harris* (2017) confirmed that one purpose of the Voting Rights Act is to provide an opportunity for minority groups to elect a candidate, not simply make up a certain percentage of a district’s population. *Cooper* also reaffirmed *Bush v. Vera* that partisan gerrymandering, while not explicitly prohibited, can become racial gerrymandering if race is used to identify a partisan group. Table 3 provides a summary of cases related to race.
<table>
<thead>
<tr>
<th>Year</th>
<th>Case</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td><em>Thornburg v. Gingles</em></td>
<td>Outlined when § 2 of Voting Rights Act requires creation of majority-minority district:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Minority group is populous enough in one area to make up a majority in a district</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Minority group members vote alike</td>
</tr>
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<td></td>
<td></td>
<td>3. Majority group votes as a bloc to generally win</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Bartlett v. Strickland</em> (2009) adds requirement for minority group to be majority of voting-age population</td>
</tr>
<tr>
<td>1993</td>
<td><em>Shaw v. Reno</em></td>
<td>Strangely shaped districts will be struck down if they are based on race—first reference by Court of TDPs</td>
</tr>
<tr>
<td>1995</td>
<td><em>Miller v. Johnson</em></td>
<td>A racial gerrymander is evident if race is the predominant factor in drawing district lines</td>
</tr>
<tr>
<td>1996</td>
<td><em>Bush v. Vera</em></td>
<td>Majority-minority districts need to adhere to TDPs and be reasonably compact to avoid being struck down as a racial gerrymander</td>
</tr>
<tr>
<td>2013</td>
<td><em>Shelby County v. Holder</em></td>
<td>Preclearance requirements in § 5 of Voting Rights Act no longer apply—all states may change voting laws without prior approval</td>
</tr>
<tr>
<td>2015</td>
<td><em>Alabama Legislative Black Caucus v. Alabama</em></td>
<td>Equal population is constitutional mandate when redistricting; racial gerrymandering claims cannot be made against an entire state plan but must be made district-by-district; ability of minorities in majority-minority districts to elect a candidate of choice takes precedence over maintaining certain minority percentages</td>
</tr>
<tr>
<td>2017</td>
<td><em>Cooper v. Harris</em></td>
<td>Partisan gerrymandering may become racial gerrymandering if race is a predominant consideration in reaching partisan outcome; a minority group’s ability to elect a candidate of choice is the standard, not numerical percentages in a district</td>
</tr>
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</table>
Cases Relating to Partisanship

The issue of partisan gerrymandering has a mixed history in the Supreme Court. Cases in the 1970s and 1980s suggest that the Court was concerned with partisan gerrymandering along lines similar to issues of population equality or racial gerrymandering. However, the composition and political leaning of the court changed markedly between the 1980s and the 2000s. By the time of Vieth v. Jubelirer (2004) a plurality of justices held the opinion that partisan gerrymandering was a political, not a legal, question. This view was reiterated in Gill v. Whitford (2018) but since the case was remanded for lack of standing, no official pronouncement on the justiciability of partisan gerrymandering was made. This changed with Rucho v. Common Cause (2019) when a 5-4 majority declared that partisan gerrymandering is not justiciable. The history of the Supreme Court’s attempts to wade into the partisan gerrymandering swamp is short-lived and starts with Gaffney v. Cummings (1973).

Gaffney v. Cummings (1973) followed closely after the 1960s wave of population equality cases that enshrined the concept of one person, one vote. This electoral fairness focus was evident in the Gaffney decision where a 6-3 majority ruled that districts drawn to achieve an electoral outcome in proportion with state-wide numbers of partisan voters was constitutional (National Conference of State Legislatures, 2019a). For example, if Republicans make up 55% of a state’s voters, it is permissible to design districts that will likely award 55% of the seats to Republicans in an election. This concept that the proportion of seats won by a party should mirror the overall proportion of votes for that party is commonly known as the “seats-votes relationship” or the “seats-votes curve” (Browning & King, 1987; Tufte, 1973). There is a rich academic literature on seats-to-
votes methodology, and it appeared that such measures might make their way into the Court to aid in decision making. They did, for a time, until the Court abandoned discussion of partisan gerrymandering entirely.

Prior to *Davis v. Bandemer* (1986), the Court routinely refused to wade into the political thicket of partisan gerrymandering (Grofman, 1985). That seemed to be the case again in *Bandemer* when the Court held that lack of proportional representation is not the same thing as lack of political power, rejecting plaintiffs’ Equal Protection Clause justification. A group bringing such a claim needed to show both discriminatory intent and effect (National Conference of State Legislatures, 2019a). In spite of the Court’s rejection of the plaintiffs’ claim, it did rule that partisan gerrymandering is justiciable as a Fourteenth Amendment violation (Arrington, 2010). The Court also posited that discriminatory intent could be readily proved while discriminatory effect could not (National Conference of State Legislatures, 2019a). As such, the Court spelled out the criteria that would indicate this discriminatory intent. However, under the excessively stringent rules established by *Bandemer*, no subsequent political gerrymander was ever negated (Stephanopoulos & McGhee, 2015).

*Vieth v. Jubelirer* (2004) marks a transition between the old and the new. According to Arrington (2010), *Vieth* confirms that partisan gerrymandering is unconstitutional. However, the Court refused to strike down a Pennsylvania districting plan on grounds of partisan gerrymandering due to lack of agreement on any standard for identifying it (Arrington, 2010). Partisan gerrymandering was unconstitutional, but the justices could not agree on how to know when one exists. As a result of this, and plaintiff’s lack of success proving partisan gerrymandering under the *Bandemer* criteria,
four justices opined that partisan gerrymandering should not be justiciable (Stephanopoulos et al., 2018). Justice Kennedy, siding with the plurality opinion except with regard to whether or not partisan gerrymandering cases were justiciable, maintained the possibility of judicial action on these cases, possibly on First Amendment grounds (Stephanopoulos et al., 2018). This effectively negated the Bandemer criteria. The Justice’s disagreement about workable metrics to identify partisan gerrymandering encouraged a wide array of scholars to take up the problem and provide metrics for the Court to use. By the time of Gill v. Whitford (2018) the efficiency gap measure was introduced as a way to identify partisan gerrymandering. However, the Court had changed since Vieth and measures that might have been embraced then were not as well received by the justices in 2018.

Gill v. Whitford (2018) was a case involving an alleged partisan gerrymander in Wisconsin. In a unanimous decision, the case was dismissed for lack of standing by the plaintiffs. In spite of this, the case was revealing on several fronts. Since Gaffney, various metrics had been introduced in the Court as evidence of partisan gerrymandering. Bandemer established a discriminatory intent test that no plaintiff was ever able to meet and which justices later declared unworkable. Vieth maintained that partisan gerrymandering was unconstitutional, possibly on First Amendment grounds, but four of the nine justices now thought it was not justiciable. This was partly due to lack of consensus about how a partisan gerrymander might be accurately and reliably identified. Scholars responded to this confusion by developing metrics that could quantify partisan gerrymanders. Their hopes were dashed, however, when Chief Justice Roberts derided the efficiency gap, one of the metrics introduced, as “sociological gobbledygook” during
oral arguments in Gill (2017). While only the efficiency gap method of identifying partisan gerrymanders was discussed at length, oral arguments suggest that the conservative majority on the Court was not amenable to any metric.

This was confirmed the following year in Rucho v. Common Cause (2019) when the Court ruled that political gerrymandering cases were not justiciable. Rucho represents, in some ways, the end of a cycle that began with Baker v. Carr (1962). In delivering the opinion of the Court, Chief Justice Roberts cites Baker and the problem of courts attempting to address “political questions” (Rucho v. Common Cause, 2019).

Recall that Baker declared “that federal constitutional and statutory criteria would be enforced upon the states” (Altman & McDonald, 2012, p. 1179). Thus began the Court’s involvement in the redistricting process, first by addressing population equality between districts, which was often really racial vote dilution, and then by addressing racial gerrymandering itself. Early partisanship cases followed in the tradition of the population equality cases. First the Court ruled that they were justiciable and then tried to figure out how to identify them. By the time of Vieth, however, the Court had changed course, no longer sure that partisan gerrymandering was even justiciable. Along with a newfound doubt about the Court’s role in redistricting, the Court also questioned much of what had come before. Shelby County v. Holder (2013) saw the Court negate parts of the Voting Rights Act followed shortly by rejection of any metrics to identify partisan gerrymandering in Gill. In what may be the final act, at least for a while, the Court abandoned any effort to resolve partisan gerrymandering claims in Rucho. What remains of the 58-year involvement of the Court in questions of redistricting is one person, one
vote and a continued opinion that racial gerrymandering remains unconstitutional and justiciable. Table 4 provides a summary of cases related to partisan gerrymandering.

Table 4

<table>
<thead>
<tr>
<th>Year</th>
<th>Case</th>
<th>Significance</th>
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<tbody>
<tr>
<td>1973</td>
<td>Gaffney v. Cummings</td>
<td>Drawing districts to achieve election outcomes in proportion to partisan voting strength is constitutional</td>
</tr>
<tr>
<td>1986</td>
<td>Davis v. Bandemer</td>
<td>Partisan gerrymandering claims are justiciable; established measures to identify partisan gerrymandering—no partisan gerrymander ever met these standards and they were discontinued following Vieth v. Jubelirer (2004)</td>
</tr>
<tr>
<td>2004</td>
<td>Vieth v. Jubelirer</td>
<td>Court did not intervene but a plurality of justices believed that partisan gerrymandering claims were not justiciable, a reversal from Bandemer; no workable standard to reliably identify partisan gerrymandering exists—this seeming call for a standard led to many academic methods to identify partisan gerrymandering which were then dismissed partially in Gill v Whitford (2018) and finally in Rucho v. Common Cause (2019) when the Court declared partisan gerrymandering to not be justiciable after all</td>
</tr>
<tr>
<td>2018</td>
<td>Gill v. Whitford</td>
<td>Plaintiffs lacked standing and the case was remanded; case was significant for efforts to employ a partisan gerrymandering measure, the efficiency gap—Chief Justice Roberts referred to methodology as “sociological gobbledygook,” dashing hopes of reaching an acceptable standard to measure partisan gerrymandering</td>
</tr>
<tr>
<td>2019</td>
<td>Rucho v. Common Cause</td>
<td>Partisan gerrymandering is not justiciable; opinion consolidated with Lamone v. Benisek (2019); racial gerrymandering and one person, one vote claims remain justiciable</td>
</tr>
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</table>

Traditional Districting Principles
With that background on Supreme Court cases that have come to govern the redistricting process, it is time to look at those principles. TDPs are commonly used practices that guide the redistricting process. As we have seen, the Supreme Court first recognized TDPs in *Shaw v. Reno* (1993). Appellants in the case alleged racial gerrymandering on the basis of irregularly shaped districts which appeared to be drawn solely for the purpose of concentrating black voters into two districts (*Shaw v. Reno*, 1993). The allegation hinged, in part, on the fact that normal considerations like “compactness, contiguousness, geographical boundaries, or political subdivisions” were disregarded in favor of what appeared to be simple racial gerrymandering (*Shaw v. Reno*, 1993, 637). The Court suggested that adherence to these traditional principles could serve as evidence of a good faith effort to redistrict without malintent (*Shaw v. Reno*, 1993, 642). *Bush v. Vera* (1996) confirmed these traditional principles with Justice O’Conner writing the Court’s opinion, noting that “[s]trict scrutiny would not be appropriate if race-neutral traditional districting considerations predominated over racial ones” (964). The Court was careful to point out that these principles were not “constitutionally required” but could serve “to defeat a claim that a district has been gerrymandered on racial lines” (*Shaw v. Reno*, 1993, 647). The Court continues to cite TDPs, most recently in *Rucho v Common Cause* (2019). Current TDPs include contiguity, compactness, Voting Rights Act compliance, incumbent protection and preservation of prior district cores, political subdivisions, and communities of interest (National Conference of State Legislatures, 2009; Webster, 2013). Although population equality is not listed here among the TDPs, it is a constitutional requirement and will be discussed along with the other principles.

*Equal Population*
Population equality is a long-standing principle, enshrined since the reapportionment cases of the 1960s as a constitutional mandate. Along with contiguity and compactness, population equality was one of the early districting principles used to judge district plans (Webster, 2013). An equal population requirement between districts was always present in the Constitution, but not always adequately applied or enforced. Baker opened the door for federal involvement in what was otherwise a state function by finding that redistricting cases were justiciable. Wesberry made congressional districts justiciable and stated that districts should contain nearly equal populations. Reynolds ruled that both houses of bicameral state legislatures must be apportioned based on population and should contain nearly equal populations. From these cases comes the principle of one person, one vote that remains today. Gaffney provided for a potential 10% population deviation, but 10 years later that was replaced by the mathematical equality requirement of Karcher for congressional districts. State legislative population equality requirements are based on different constitutional grounds than congressional districts and some still use the 10% deviation standard (Arrington, 2010). According to the National Conference of State Legislatures (2019a), population equality for congressional districts required in Wesberry stems from art. 1, § 2 of the Constitution and the strict population equality of Karcher applies. However, the equal population requirement for state legislative districts mandated by Reynolds is based on the Fourteenth Amendment’s Equal Protection Clause and requires nearly equal populations.

Equal population measures are based, in part, on Evenwel v. Abbott (2016) which said that total population was an appropriate metric for determining district size. As such, U.S. Census population numbers are used to determine the total population of a state and
that population is then divided by the number of congressional districts allocated to the state. This determines the individual district’s population and is known as the “ideal population” (National Conference of State Legislatures, 2009, p. 23). What is needed in determining population equality is deviation from this ideal. Absolute population deviation is the raw number above or below the ideal population while relative population deviation is absolute deviation divided by the ideal population (National Conference of State Legislatures, 2009). If a district’s ideal population is 10,000 and it is drawn containing 10,300 people, its absolute deviation is +300. Divide that +300 by the ideal population of 10,000 and you get a relative deviation of .03 or 3%. A commonly used measure for comparing population equality between districts is the range. Range is the population difference between the smallest and the largest district and can be expressed as a raw number or as a percentage (National Conference of State Legislatures, 2009). If the largest district contains 10,300 people and the smallest district contains 9,700 people, then the range is 600 people. For congressional districts governed strictly by Karcher, the range should be zero or as close to it as possible. For state districts meeting a less stringent standard, “the difference between the largest and smallest district must be less than 10% of the mean size of the districts” (Arrington, 2010, p. 8).

Requiring population equality between districts served a valuable purpose of apportioning districts more fairly in places where unequal population was being used to dilute voting strength, particularly of minority groups. However, the “absolute population equality…imposed by Karcher,” has had detrimental effects on other traditional principles (Altman, 1998b, p. 185). Preserving political boundaries and making districts compact, two fundamental districting principles, is made more difficult by the stringent
population equality requirements (Jacobson, 2016). As proof of this, Altman (1998b) found that after the Wesberry and Reynolds decisions, the number of political subdivisions split to attain population equality tripled. Morrill (1981) sums up the problem nicely by writing that it “has proven impossible to reconcile the desire to use counties and cities as the unit of representation with the constitutional requirement for equal population” (p. 25). Strict population equality also makes it difficult or impossible to completely capture communities of interest (Forest, 2001). In addition, strict population equality adds to the difficulty of the mapmaker seeking to find the perfect census block with the exact population to properly complete a district (Webster, 2013). All of this points to a persistent problem with multiple redistricting criteria. Each criterion may, and quite often does, conflict with another such that accomplishing one negates the other. This will have implications for how, exactly, the redistricting commission accomplishes its task of drawing congressional district boundaries for Colorado after the 2020 census count.

**Contiguity**

Contiguity is a common requirement due to the nature of geographical representation and, as such, is a requirement in nearly all states. Contiguity refers to a continuous whole territory not divided into separate disconnected pieces (Arrington, 2010). Contiguous territory means that a person can travel from any point in an area to any other point in the same bounded area without having to cross a boundary line (Altman & McDonald, 2012; Grofman, 1985; Herbert, 2000). Contiguity is one of the oldest TDPs, in spite of no legal history in the high courts, and is often written into state constitutions as a required redistricting criterion (Arrington, 2010; Webster, 2013).
Contiguity can become an issue in places where bodies of water, or other physical features, act as barriers. These situations require the exercise of judgment and a common approach is to permit transportation links, such as water transportation, to establish contiguity.

The measure of contiguity is binary. A district either is or is not contiguous and that determination comes directly from the definition. One refinement to the definition deals with point contiguity which refers to contiguity at a single dimensionless point such as where the points of two triangles may touch (Arrington, 2010). Point contiguity meets the technical definition of contiguity, except where specifically prohibited, but is much more likely to draw scrutiny and legal challenges.

Limitations of contiguity as a redistricting principle are generally related to its effectiveness in promoting fairness. While it may be argued that discontiguous districts are fair if the purpose is to join separated areas with common characteristics, it is generally accepted that contiguity is better employed as a check on partisan manipulations (Morrill, 1973). By imposing certain restrictions on district boundaries, it is thought that contiguity can serve as a check on gerrymandering. It does that by prohibiting map drawers from making a district out of unconnected pieces of territory, but its actual effectiveness at thwarting gerrymandering is questionable. This is due, in part, to partisan voters not being uniformly distributed across geographic space.

Another practice that limits contiguity’s effectiveness at thwarting partisan boundary manipulation is the use of geographic information systems (GIS). GIS is computer software designed to integrate various types of data into a computer mapping environment. The data can be manipulated, analyzed, and reconfigured to meet different
needs. With more and more detailed data available about individual voters, GIS assists partisan operatives in their gerrymandering efforts, in spite of the seeming restrictions imposed by TDPs. Where contiguity may have once imposed a roadblock to drawing partisan districts, it is now little more than a speed bump. Nonetheless, contiguity continues to be cited by the Court as a traditional principle whose disregard can be construed as evidence of malintent (*Rucho v. Common Cause*, 2019).

**Compactness**

Compactness is another geographic criterion applied to redistricting (Morrill, 1973; Reock, 1961; Winburn, Henderson, & Dowling, 2016). It is among the oldest and most often cited districting principle in spite of no federal law requiring its use (National Conference of State Legislatures, 2009; Webster, 2013). Compactness is included as a legal redistricting requirement for congressional districts, state legislative districts, or both in 36 of 50 states (National Conference of State Legislatures, 2009; Winburn et al., 2016). Like contiguity, compactness has long been cited as a check on partisan gerrymandering. Justice Stevens wrote in his concurrence in *Karcher v. Daggett* (1983) that “drastic departures from compactness are a signal that something may be amiss” (p. 758). In addition to potentially thwarting partisan manipulation, compactness offers simplicity of shape that may lead to less confusion by voters (Engstrom, 2005). *Shaw v. Reno* (1993) was the first time that the Supreme Court used compactness as the foundation of a constitutional infraction (Pildes & Niemi, 1993; Webster, 2013). It has been cited in Supreme Court cases as a TDP ever since (Altman, 1998b).

Before compactness was cited as a TDP, the Court generally relied on simple visual inspection to determine a district’s compactness (Altman & McDonald, 2012).
With the elevation of compactness to a potential standard by which district plans could be found unconstitutional, the need for quantifiable measures was apparent. Today there are numerous metrics scholars use to compute compactness and test its overall shape. These metrics fall into one of three broad categories based on area, perimeter, or population with the simpler being dispersion (area) or perimeter (Altman, 1998a; Bowen, 2014; Chambers, 2010; Herbert, 2000; Pildes & Niemi, 1993). Dispersion refers to “how tightly packed or spread out a district is” (Herbert, 2000, p. 450). Dispersion measures compare things like a district’s length to its width or its area to that of a circle surrounding it (Chambers, 2010). Perimeter measures seek to capture how much a district’s boundaries deviate from a smooth figure like a circle or square. Since it is possible to meet dispersion criteria while violating perimeter standards and vice versa, scholars often recommend measuring multiple attributes to adequately determine the true compactness of a district (Niemi, Grofman, Carlucci, & Hofeller, 1990).

**Reock Compactness Measure.** The National Conference of State Legislatures (2009) cites three commonly used compactness measures in the wake of *Karcher v. Daggett* (1983). These are the Reock, Schwartzberg and total perimeter tests (National Conference of State Legislatures, 2009). Reock (1961) proposed that a circle, “as the most compact plane figure,” be used as a standard by which to judge the overall compactness of district shapes (p. 71). The relationship between a district’s area and that of “the smallest possible circumscribing circle” that surrounds it yields a measure of overall compactness (Reock, 1961, p. 71). Reock scores fall between zero and one with scores closer to one being more compact. Figure 1 illustrates the Reock geometry using Denver County as an example and the following hypothetical operation will illustrate the
math. Assume that Denver County is 154.6 square miles and the area of the smallest circumscribing circle is 855.3 square miles. The Reock compactness score is the area of the county divided by the area of the surrounding circle: 154.6 divided by 855.3 equals .18. For comparison, Denver’s Reock score if its area were in the shape of a perfect square would be .64. This method works best when applied to many districts such that an average measure of compactness can be computed. Then, deviations from the average stand out. This method has obvious shortcomings with oddly shaped states such as those with protruding panhandles or those with numerous water inlets or islands (Reock, 1961).

Figure 1

Reock Compactness Illustration for Denver County.

Schwartzberg Compactness Measure. The Schwartzberg method is similar to the Reock in that it employs a circle as the most compact shape and compares the perimeter of the proposed district to “the perimeter of a circle of equal area” (Schwartzberg, 1965, p. 444). The main difference between Reock and Schwartzberg is that the Reock measure uses a ratio of two areas while the Schwartzberg method uses a ratio of two perimeters. As the most compact shape, a circle encompasses the most area
with the smallest possible perimeter. Comparing this to a district’s perimeter gives an idea of how efficiently, or not, a proposed district’s shape captures its area. Original Schwartzberg scores started at one—a perfect circle—and progressed upward from there as district shapes became less compact (Schwartzberg, 1965). A more common variant takes the inverse of the Schwartzberg score so that values fall between zero and one with values closer to one being more compact (Niemi et al., 1990). Figure 2 illustrates the geometry and the following hypothetical operation illustrates the math. Assume that Denver County is 154.6 square miles. The Schwartzberg method calculates the circumference of a circle with the same area and compares the district perimeter with that circumference. The circumference of a circle with an area of 154.6 square miles is 44.1 miles. The Schwartzberg compactness score is the county perimeter divided by the circumference of the surrounding circle. If Denver’s perimeter is 163.1 miles and the circle circumference is 44.1, then 163.1 divided by 44.1 equals 3.7 and its inverse is .27. Denver’s Schwartzberg score is .27. For comparison, the Schwartzberg score if Denver’s area was a perfect square would be .88. It should be noted that matching a circle’s efficient encapsulation of a given area is not the goal of redistricting. No district will achieve a score of one, nor is that necessarily a goal. Rather, deriving measures like the Schwartzberg score provides a method of comparing district shapes and discovering outliers. As with the Reock score, the Schwartzberg method yields relative numbers that are best understood by computing many of them and then comparing various district shapes to each other.
Schwartzberg Compactness Illustration for Denver County.

Polsby-Popper Compactness Measure. While not explicitly named by the National Conference of State Legislatures, a calculation similar to the Schwartzberg method is worth mentioning due to its frequent appearance in the literature. In response to Shaw v. Reno (1993), Pildes and Niemi (1993) identified three relevant measures and settled on two, dispersion and perimeter, as the most appropriate measures of compactness. These two measures are most commonly known by the names of those who advocated their use, Reock and Polsby-Popper (Webster, 2013). The Reock method is a dispersion measure of compactness already discussed while the Polsby-Popper method is a modification of Schwartzberg. Polsby and Popper (1991) concur with Schwartzberg that a circle most efficiently encapsulates a given area since its perimeter per unit area is the smallest. As such, it is once again used as the comparison shape. Unlike Schwartzberg who used a ratio of perimeters, Polsby-Popper divides the district area by the area of a circle with circumference equal to that of the district perimeter. This yields an absolute measure of how efficiently a district perimeter encompasses an area. The Polsby-Popper score is an index from zero to one with values closer to one being more compact. Figure 3 shows Denver County as an example of the geometry involved and the
following hypothetical operation illustrates the math. Assume Denver County is 154.6 square miles with a perimeter of 163.1 miles. The area of a circle with circumference equal to the county’s perimeter is 838.8 square miles. The Polsby-Popper score is the area of the county divided by the area of the surrounding circle: 154.6 divided by 838.8 equals .18. For comparison, the Polsby-Popper score for a perfect square with the same area is .79. The Polsby-Popper method captures deviations from compact shapes since irregular boundaries add to the overall perimeter thus making it less efficient at encompassing a given area.

Figure 3
Polsby-Popper Compactness Illustration for Denver County.

Total Perimeter Compactness Measure. The final compactness measure is the total perimeter test (National Conference of State Legislatures, 2009). The total perimeter method simply adds up the length of all district lines (Polsby & Popper, 1991). Perimeter tests found favor because of the underlying belief that a smaller total perimeter equates to a more compact design (Horn, Hampton, & Vandenberg, 1993).
the most compact districts should produce the smallest total perimeter. On this basis, some states have adopted a perimeter test as a criterion for constructing district boundaries (Horn et al., 1993). In practice, however, the previously mentioned tests that use perimeter as just one measure toward the computation of area or perimeter ratios are generally agreed to better capture overall district shape properties. The Colorado Constitution specifies a perimeter compactness measure and this research will compute that along with the Schwartzberg method to evaluate district shapes.

Compactness is limited in its applicability due to differing, and sometimes contradictory, computational methods and the fact that widely divergent geographies make a single standard of compactness impractical (Arrington, 2010; Grofman, 1985; Herbert, 2000). Maryland’s shape, for example, with its miles of coastline along the Chesapeake Bay and its southern border following the Potomac River, does not lend itself to easy compactness measures that can identify partisan gerrymandering from geographic meandering. Denver County’s shape is not very compact, based on the measures examined, but that alone does not provide complete information. While many in the public, and some scholars, believe that compactness limits gerrymandering, it remains a subject of debate and a principle that is not universally accepted (Bowen, 2014; Niemi et al., 1990; Webster, 2013). Arrington (2010) writes plainly that scholars do not find that compactness limits gerrymandering for partisan advantage. Given the power of GIS and ever finer levels of voter detail provided both by the U.S. Census Bureau and data mining companies, the effectiveness of compactness at thwarting partisan gerrymandering is lessened.

Preserving Political Subdivisions
Respect for political subdivisions during redistricting has a long history and is a TDP recognized by the Supreme Court (Arrington, 2010; Herbert, 2000). Preserving political subdivisions means positioning district lines such that whole political units like counties and towns are completely in the district, not portions of them. Nineteen states require the preservation of political subdivisions during congressional redistricting and 42 require it for state legislative district boundaries (National Conference of State Legislatures, 2009). Morrill (1987) cites three primary reasons for preserving political subdivisions: (1) local governments are “legal and familiar communities of interest,” (2) cities and counties are the basic unit of political representation, and (3) honoring them may serve as an obstacle to political gerrymandering (p. 251). The Colorado Constitution calls for the preservation of “whole political subdivisions, such as counties, cities, and towns…as much as is reasonably possible” (Senate Concurrent Resolution 18-004, § 44.3).

Measuring preservation of political subdivisions involves counting the number of split counties, cities, towns and other governmental units (Engstrom, 2002). The first task is to specify what, exactly, constitutes a political subdivision. In addition to those already mentioned, political subdivisions may include municipalities, school districts and even special purpose areas like water districts (Engstrom, 2002). This research will focus on counties as political subdivisions as they are one of the administrative units specified by the state constitution and are readily evaluated for splits.

The primary limitation of political subdivision preservation, as with other redistricting criteria, is that it often conflicts with higher priority principles and is frequently violated (Webster, 2013). Courts have routinely found that equal population
takes precedence over preserving political subdivisions and this necessitates splitting counties and towns (Grofman, 1985). Since it is highly unlikely that a collection of counties and towns drawn into a common district will have populations that sum to the ideal number, it is clear that equal population necessitates the violation of political subdivisions.

**Voting Rights Act Compliance**

Compliance with the Voting Rights Act of 1965 is cited as a TDP. It was covered in the legal review and will be only briefly summarized here. The Voting Rights Act was designed to outlaw “redistricting plans that diluted black voting strength” (Forgetter & Winkle, 2006). It sought to fully enforce the right to vote guaranteed by the Fifteenth Amendment to the Constitution (National Conference of State Legislatures, 2009). The Act’s § 2 prohibits “election practices and procedures designed to deny the right to vote based on race or color (later expanded to include language minority groups)” and is applicable to every jurisdiction in the United States (Coleman, 2014, p. 14). The formula to determine which jurisdictions are subject to the § 5 preclearance requirement is provided by § 4(b). States and their subdivisions identified by the §4(b) coverage formula are prohibited by § 5 from changing election procedures or practices without prior approval from the U.S. Department of Justice or the District of Columbia District Court (Coleman, 2014). As described in the legal overview, § 4(b) was found unconstitutional in *Shelby County v. Holder* (2013) which effectively voided the § 5 preclearance requirement. The Voting Rights Act § 2 remains applicable to redistricting and the various court cases surrounding racial equity govern how it is applied.
Objective measures of Voting Rights Act compliance are difficult due to the inherently political and legal nature of racial equity. The three-pronged Gingles test remains a guide for when to draw majority-minority districts, but it is unclear if those 1986 criteria will prevail in the long run. Another possible objective measure of compliance could be the *Miller v. Johnson* (1995) decision where the Court held that adherence to race-neutral TDPs could thwart an unconstitutional finding of an otherwise race-based district (National Conference of State Legislatures, 2009). Procedural processes, then, rather than any numerical metrics, seem to be the measure of Voting Rights Act compliance. Given the Court’s dismissive response to objective measures introduced in the *Gill* partisan gerrymandering case, these procedural processes may be as close as the Court gets to an objective measure of racial equity. Limitations of the Voting Rights Act as a TDP are tied directly to the lack of objective measures. The only way to determine compliance is in the courts. As such, racial equity measures and limitations will be dictated by existing and future Court decisions.

**Communities of Interest**

Communities of interest were officially recognized by the Supreme Court as a TDP in *Miller v. Johnson* (1998) (Leib, 1998). Ten states require preservation of communities of interest in congressional district plans and 19 require it for state legislative districts (National Conference of State Legislatures, 2009). The rationale behind communities of interest is that citizens with shared characteristics and perspectives should remain together in a single district (Webster, 2013). Unfortunately, there are no clear definitions for community of interest or specific guidelines to follow in delineating them (Forest, 2004; Leib, 1998). As Morrill (1987) notes, communities of
interest may be “the least well-defined but the most geographic criterion” used in redistricting (p. 251). Definitional attempts illustrate the lack of agreement and the resulting overly broad categories limit the concept’s usefulness. One definition provided by Shelley et al. (1996) suggests that spatially collocated people “with common economic, social, political, or cultural interests” make a community of interest (p. 177). Other options range from occupation to religious affiliation to social activities (Morrill, 1987). Levitt (2011) provides an even lengthier list of characteristics that could define a community of interest: social interests, cultural interests, racial/ethnic interests, economic/trade interests, geographic interests, communication and transportation networks, media markets, urban and rural interests, occupations and lifestyles (slide 48). The Colorado Constitution muddies these waters further by specifying that a community of interest

means any group in Colorado that shares one or more substantial interests that may be the subject of federal legislative action, is composed of a reasonably proximate population, and thus should be considered for inclusion within a single district for purposes of ensuring its fair and effective representation” (Senate Concurrent Resolution 18-004, § 44(3)(b)(I)).

It is hard to think of what would not fall under this rubric. The definition goes on to specify that concerns of “urban, rural, agricultural, industrial, or trade areas; and…education, employment, environment, public health, transportation, water needs and supplies, and issues of demonstrable regional significance” may be included as interests (Senate Concurrent Resolution 18-004, § 44(3)(b)(II)). As the literature and Colorado’s constitution reveal, defining a community of interest remains elusive and that
fact limits its usefulness in the redistricting process unless extensive prior work is done to identify such communities before the redistricting process begins.

Measuring communities of interest is as difficult as defining them. Morrill (1987) suggests two ways to measure communities of interest. He suggests that proposed district plans be compared to others designed for the purpose of prioritizing communities of interest. This allows for a subjective visualization of how well a proposed plan captures communities of interest identified in a model. Morrill’s other suggestion is to “measure whether rural, suburban or inner-city voters are systemically packed or split to minimize their representation” (p. 252). This is less an objective measure than an attempt to see if racial, or perhaps partisan, gerrymandering is afoot. Another possibility is to use “political units or media markets as proxies” for communities of interest (Phillips & Montello, 2017, p. 33). This idea of using another defined geographic unit to act as a surrogate for community of interest is one that appears repeatedly in the literature. One example of using a surrogate is assigning census tract-level socioeconomic data to various classes and then mapping those classes as communities of interest (Phillips & Montello, 2017). Alternately, census designated places can be used as “cultural places” to represent a community (Rossiter, Wong, & Delamater, 2018, p. 4). Sociodemographic data may be used to identify people with similar voting patterns which may indicate similar interests and thus constitute a community (Rossiter, Wong, & Delamater, 2018). Two common features emerge from these approaches. First is a lack of truly objective metrics that are reproducible in multiple locations. Second is the apparent need to employ a proxy for community of interest. Taken together, this definitional ambiguity and lack of objective measures imposes limits on communities of interest as a redistricting principle.
The practical limitations of communities of interest go beyond definitional and measurement ambiguity. Forest (2004) points out how the use of GIS can shape the definition of community of interest. Since states use GIS to accomplish the redistricting process, communities of interest will likely be “limited to spatially defined, territorially bounded communities” for which data already exists (Forest, 2004). This means that communities of interest may ultimately be defined by data available for the computer program. If definitions can be agreed upon and data found to represent the community, there is then the difficulty in identifying communities prior to the start of redistricting (Arrington, 2010). As a geographic criterion, the concept of community of interest is appealing to geographers and mapmakers. As a practical matter, an overly broad definition and limited means of objective measurement diminish its usefulness. All of this may indicate why, as Altman & McDonald (2018) point out, communities of interest have largely been disregarded in practice.

Due to this difficulty defining and quantifying a community of interest, Arrington (2010) finds that “it is rarely operationalized…to make it useful in either drawing or evaluating districts” (p. 6). As a way around this, scholars suggest that political subdivisions, like counties or cities, can be used as a surrogate for communities of interest (Bowen, 2014; Leib, 1998; Morrill, 1987; Phillips & Montello, 2017; Rossiter et al., 2018; Stephanopoulos, 2012). This is not to suggest that geographers believe the two are the same thing; they do not, and the literature is rich with efforts to accurately identify and spatially bound communities of interest. The logic of using political subdivisions as a representation of communities of interest is based on the idea that people in proximity have de facto shared concerns. They interact with each other in commerce, governance
and worship. They share traffic congestion, natural disasters, crime, and cultural opportunities. They endure the results of decisions made by local governmental institutions. In short, people occupying the same political subdivision make up a community of interest whether or not they share the same political views because they have common concerns as neighbors. This research embraces that approach and will use political subdivisions, counties specifically, as a surrogate for communities of interest.

Protecting Incumbents and Prior District Cores

Protecting incumbents and preserving prior district cores are TDPs that will be discussed together due to their similarities. Both were recognized by the Court in Abrams v. Johnson (1997) as TDPs (National Conference of State Legislatures, 2009). No state requires incumbent protection in congressional districts, although seven allow it, and Colorado has joined the list of five states that prohibit it (National Conference of State Legislatures, 2009; Senate Concurrent Resolution 18-004, § 44.3). Seven states require preserving prior district cores, three allow it, and none prohibit it (National Conference of State Legislatures, 2009). The main logic behind incumbent protection is seniority and leadership opportunities in Congress for a state’s representatives (Webster, 2013). The longer a representative remains in Congress, the more likely they are to advance to a leadership position and thus bring more prestige and opportunities to the state. The main logic behind preserving district cores is district stability which fosters “connection between legislators and their constituents” (Grofman, 1985, p. 111). These two criteria complement and reinforce one another. This research will not honor incumbent protection because that criterion is prohibited under the Colorado Constitution since approval of Amendment Y. This research will also not seek to preserve prior district cores because it
is not required by the Colorado Constitution and the new competitive criterion will necessarily break up prior district cores.

**Competitive Districts**

The requirement to draw competitive congressional districts is a recent phenomenon. Competitive districts are not listed as one of the TDPs and very few states have a competitive requirement in place (Arrington, 2010; National Conference of State Legislatures, 2009; Webster, 2013). Four states currently have a requirement to make congressional districts competitive: Arizona, Washington, New York and Colorado (National Conference of State Legislatures, 2019c). Colorado adopted competition as a principle in 2018 with approval of Amendment Y, specifying that competitive districts should be sought after meeting other traditional principles. There are two broad purposes behind drawing competitive districts. First is the idea that competitive races lead to more moderate representation due to the need to appeal to voters in the middle of the partisan spectrum (Lindgren & Southwell, 2014). The logic is that close races imply a need to appeal to a full range of voters and therefore moderate extreme voting behavior. While evidence for this moderation effect is mixed, Lindgren and Southwell (2014) conclude that both district partisanship and win margin can have an effect on representatives’ voting behavior. The second purpose for competitive districts is in line with many of the other TDPs—limit political gerrymandering. This is partly in response to political operatives’ continued ability to draw district boundaries for partisan advantage, in spite of the supposed restrictions of TDPs.

Forgette, Garner, and Winkle (2009) propose two ways to quantify competitive elections: (1) how likely an election is to be contested and (2) the win margin in elections
that are contested by the two major political parties. These two concepts are related since an uncontested election is very likely one where potential opponents found the win margins too large to overcome. Since it may also serve as a surrogate for uncontested elections, this research will adopt win margin as the most appropriate measure.

Quantifying how large a win margin should be before categorizing it as competitive is a subjective matter, but scholars most often use a 10% win margin to define a competitive race (Arrington, 2010; Forgette & Platt, 2005; Masket, Winburn & Wright, 2012). This is a reasonable mark since truly packed or very partisan districts can easily produce winning margins greater than 20%. In fact, the average margin of victory in congressional races in Colorado under the current district map from 2012 through 2018 is 25.1% (see Table 15). This implies that a 10% margin is an acceptable goal in defining a competitive race, although it will not be the most accurate number in all circumstances. The 10% win margin is more a rule of thumb than an established scientific fact and, given partisan voting patterns, mobility, and the possibility of changing attitudes, it may be impossible to divine a competitive win margin that would be applicable at all places under all circumstances. It may be best to look at win margins in a particular state or district over time and see what margins were in place when a seat changed hands, if ever. Under the existing congressional district map in Colorado, only one district has been competitive by the 10% standard and that district is the only one that has changed party control. This lends support to a 10% standard but should not be taken as a given. Forgette and Platt (2005) suggest a 10% win margin in a hypothetical two-party race as a reasonable starting point. This research will use a 10% win margin in a hypothetical two-party race as a measure of competitiveness.
Aside from the practical limitation of precisely enumerating competitive districts, there are also questions as to whether good representation and competition are compatible in geographic single-member districts (Arrington, 2010). Brunell and Buchler (2009) argue that competitive districts “increase the ideological disagreements between legislators and their constituents” and thus leads to less effective representation. This argument is based on how well the policy views of the representative and their constituents agree (Arrington, 2010). The less diverse the population, the more overall policy agreement there will be, and the representative can better reflect this view for the majority. Competitive districts, by contrast, group voters with disparate views together and have the perverse effect of causing more voters to be at odds with each other and their representative (Brunell, 2006). This argument is utilitarian, bring the greatest happiness to the greatest number of people by grouping them into uncompetitive districts (Brunell, 2006; Buchler, 2005). The logic of satisfied voters does not, however, address the minority of voters who are both unhappy with the election outcome and perceive the process to be unfair. Morrill (1987) points out the importance of “fair participation” by making sure that one of the parties doesn’t “begin with a built-in handicap” (p. 243). Perceived fairness may matter for the long-term health of democracy. As Justice Ginsberg asked during oral arguments in *Gill v. Whitford* (2018), “if you can stack a legislature in this way, what incentive is there for a voter to exercise his vote” (Heritage Reporting Corporation, 2017, p. 24)? If perceived fairness and a willingness on the part of representatives to compromise are important values, then competitive districts have a purpose. If representing the maximum number of people with shared ideology as Brunell (2006) and Buchler (2005) suggest is the goal, then uncompetitive districts would work.
Contradictory Districting Principles

An overarching limitation on the districting criteria discussed so far is that they are contradictory (Webster, 2013). The equal population requirement necessitates splitting political subdivisions and can limit compactness. Compactness can interfere with communities of interest or Voting Rights Act compliance. Keeping communities of interest together complicates the equal population requirement and creates uncompetitive districts. Compliance with the Voting Rights Act can impact compactness and preserving political subdivisions. Competitive districts conflict with communities of interest because they require diverse views that are not prevalent in homogenous communities of interest (Mann & Cain, 2005). All of this illustrates why “it is impossible to satisfy all these criteria simultaneously” (Morrill, 1987, p. 244). Given that redistricting criteria conflict, how should the Colorado redistricting commission proceed? A logical starting point is to identify a hierarchy by which to apply the various criteria.

A Hierarchical Application of Districting Principles

Prior redistricting cases in the Colorado Supreme Court cite a hierarchical approach when applying districting principles which draw directly from the state constitution (Hall v. Moreno, 2012). The Colorado Constitution lists the following mandatory redistricting criteria: mathematical population equality, contiguous geographic areas, and compliance with the Voting Rights Act of 1965. The next tier criteria are to be followed “as much as is reasonably possible” and include compactness and preservation of both communities of interest and whole political subdivisions (Senate Concurrent Resolution 18-004, § 44.3). The final tier in the hierarchy starts with the word “thereafter,” which implies application after meeting the previous two tiers’ criteria, and
directs the redistricting commission to create competitive districts “to the extent possible” (Senate Concurrent Resolution 18-004, § 44.3). This research will follow the hierarchical order spelled out in the Colorado Constitution with two exceptions. First, this research will not attempt to identify communities of interest. Recall that communities of interest are ill-defined and Colorado’s own list of potential interests that might constitute a community is too broad to be applied with any precision or consistency. As a remedy, scholars suggest using political subdivisions as a surrogate. This research will follow that approach for simplicity and because the logic suggesting that people who live in proximity represent a de facto community of interest is sound. For this research, communities of interest are synonymous with political subdivisions. Second, to evaluate the impact of the new competitive criterion on other criteria, this research will promote competitive districts above political subdivisions and compactness in the hierarchy. This is to allow evaluation and measurement of its impact on those two criteria. The following list outlines the order in which the various criteria will be applied.

- Population equality
- Contiguous geographic areas
- Comply with Voting Rights Act of 1965
- Maximize number of competitive districts
- Preserve political subdivisions/communities of interest
- Compactness

**Metrics for This Research**

Based on the literature review, this research will use the following metrics. A 10% win margin on a representative race will be the standard for competitive districts using
prior election results. The metric for preservation of political subdivisions will be a count of county splits. Total perimeter and the Schwartzberg compactness score will be employed to assess district compactness. This will meet the Colorado Constitution requirement that “the aggregate linear distance of all district boundaries shall be as short as possible” (Colo. Const. art. V, § 47, 1). Schwartzberg compactness scores will be used along with total perimeter because they capture compactness more completely than perimeter alone and are currently used by Colorado election officials to evaluate compactness. The most important fact is that measures used for comparison will be the same for both existing district boundaries and those proposed as part of this research.
CHAPTER III

METHODS

Research Problem and Question

The role of redistricting criteria is to guide the process of drawing district boundaries so that desirable attributes, such as contiguity and equal population, are attained. The research problem is that Colorado’s new competitive criterion conflicts with other districting principles and creating competitive districts will affect those criteria. Recall that some redistricting criteria are mandatory and must be met before attempting to make districts competitive. Like competitiveness, preserving political subdivisions and making districts compact are to be met as able. Of the TDPs discussed in the literature review, the Colorado Constitution and legal precedent make equal population, contiguity, and Voting Rights Act compliance mandatory. Amendment Y prohibits incumbent protection and does not require preservation of prior district cores. This leaves preservation of political subdivisions and communities of interest along with compactness and the newly enshrined competitiveness as criteria to implement as able. Recall from the literature review that political subdivisions will be used as a surrogate for communities of interest and only compactness, preserving political subdivisions, and the new competitive criteria remain to compete for implementation. Since these criteria conflict with each other where meeting one may negate another, the research question is what impact will drawing new competitive congressional districts have on measures of compactness and political subdivision preservation? The goal of this research is to evaluate the impact of prioritizing competitive districts on measures of compactness and political subdivision preservation. A subordinate research goal is to inform the
redistricting commission about geographic issues—primarily partisan voting patterns and population distribution—related to creating competitive congressional districts in Colorado.

Research Logical Structure

This research employs an action research logical structure. An action research approach seeks to answer questions of process or “how to get something done” (Spickard, 2017). This logical structure fits the research task of determining how to draw competitive districts under the constraints imposed by Colorado’s redistricting criteria. Since competitive districts require a near equal number of partisan voters from the two major parties, identifying existing voting patterns will be part of the process. Congressional districts are also required to contain equal populations, so identifying population densities that correspond with partisan voting patterns will be required as well.

Research Design

This research seeks to measure the impact of competitive districts on other districting principles. As such, the overall research design is quantitative-descriptive, using numerical data to describe elements of the redistricting process (Balian, 2011). Quantitative-descriptive designs use familiar descriptive statistics such as percentages, mean, median, and mode to describe characteristics of the phenomena under consideration (Balian, 2011). This research will use descriptive statistics to describe the demographic and partisan voting patterns of Colorado in addition to evaluating the impact competitive districts will have on measures of political subdivision splits and competitiveness.
Research Assumption

An assumption key to this research is that redistricting is possible using unsophisticated techniques and procedures. While advanced mathematics and complex computer code could certainly automate redistricting to some degree, it is questionable whether these very technical processes would be embraced by the electorate. This research assumes that the average voter expects a redistricting process that is understandable and involves the least amount of advanced technology necessary to accomplish the task. If Chief Justice Roberts’ comment about “sociological gobbledygook” is any indication, voters do not want overly complicated processes that even a Supreme Court Justice struggles to understand (Oyez, 2017). Therefore, this research will use standard GIS tools and publicly available information to evaluate the current state of congressional districts in Colorado and construct competitive districts as called for by Amendment Y. Likewise, descriptive statistics such as percentages, mean, median, and mode will be used whenever possible to describe characteristics. This approach uses readily available public data and employs software that is commercially available such that advanced academic degrees are not required to either accomplish or understand redistricting using this approach.

Validity and Reliability

All research must address the validity of measurements and how reliable those measures are. Validity asks if “the instrument accurately measure[s] what it is supposed to measure” (Balian, 2011, p. 103). This research uses GIS and publicly available data to measure various characteristics of geographic shapes and underlying demographic and election data. Recall that GIS is computer software designed to integrate various types of
data into a computer mapping environment. The data can be manipulated, analyzed, and reconfigured to meet different mapping and research needs. These are the exact same tools and data used to construct actual congressional districts. It is reasonable to expect that the computer software employed will accurately measure what it is intended to measure. Reliability refers to “the consistency of an instrument’s measurements” (Balian, 2011, p. 111). This research will use GIS to conduct routine mathematical calculations such as percent, median, and mean along with area and perimeter measures of geographic shapes. As such, consistent measurements are not in doubt, absent user error.

**Research Scope**

The scope of this study is limited to congressional districts in Colorado using demographic and electoral data unique to Colorado. Due to geography, population distribution, urban-rural split, state shape, constitutional requirements, number of congressional districts and other state differences, this research will not be generalizable to all states. However, the general techniques employed could be reconfigured to meet most states’ requirements with the understanding that local conditions in each individual state will take precedence and conclusions for Colorado may not be entirely relevant.

**Required Data**

Data used in this research includes geographic shapefiles for Colorado counties, existing congressional districts, precincts, and census blocks. 2010 block-level U.S. Census population data and 2018 election results by precinct are also required. The remaining required data can be derived from these and includes population density, partisan voting patterns, and geographic shape measurements. Quantitative methods
measure existing congressional district characteristics and compare them with those of proposed competitive districts created in this research.

2010 U.S. Census Data

2010 census blocks with demographic data were used for three reasons. First, the existing congressional districts that are used for comparison were constructed using 2010 census data. This research seeks to recreate those districts with a focus on competitiveness in order to evaluate the impact that criterion will have on measures of political subdivision splits and compactness. In order to make comparisons between proposed districts and existing districts, it is important to use the same data. Second, more recent demographic data available via the American Community Survey are reported at the block group level. This introduces the modifiable areal unit problem (MAUP) due to the arbitrary nature of the block group aggregation in regard to the phenomena being investigated (O’Sullivan & Unwin, 2010). MAUP refers to the impact the assigned areal unit has on observed relationships and patterns (O’Sullivan & Unwin, 2010). A different spatial unit, census blocks vs. block group for example, may result in different spatial relationships. Additionally, breaking block groups down into block-level data necessarily involves the introduction of error into the results. This is because a block group is composed of numerous census blocks and efforts to distribute the larger unit data among many smaller units involves averages and estimations about what share of the larger group belongs to each of the smaller units. This reduction in overall quality of the data is unacceptable when block-level data is available. Finally, a subordinate goal of this research is to instruct the Colorado redistricting commission on how to create competitive congressional districts following the 2020 census count. Using 2010 census data allows
this research to serve as a model that can be recreated using 2020 census data when it becomes available.

A 2010 census blocks shapefile with demographic data was downloaded from the Colorado State Demography Office. The file contains 201,062 census blocks with demographic data from the U.S. Census Bureau’s Summary File 1 (SF1) for Colorado (C. DeGroen, personal communication, February 12, 2020). SF1 contains housing and population characteristics for the entire Colorado population. Population data includes “sex, age, race, Hispanic or Latino origin, household relationship, household type, household size, family type, family size, and group quarters” (“Summary File 1,” n.d.). SF1 also includes housing information such as occupancy, vacancy, and owner versus renter status. This shapefile provides geolocated demographic data for Colorado at the census block level. The file was preprocessed for later joining with precincts using ArcGIS Pro Feature to Point Data Management tool. This allows attribute data to be assigned to a single point for more accurate spatial joining to precinct polygon shapes that do not align entirely with census block boundaries.

**Colorado Precincts**

Precinct shapefiles for Colorado were downloaded from a link provided by the Colorado State Demography Office. The download contained 64 precinct files that were compiled from inputs from each of Colorado’s counties. The initial files contained only geolocated polygons with an identifier name and number. The individual files were preprocessed to match election reporting results for later joining. The precinct files contained a 6-digit identifier that was a concatenation of the U.S. Census Bureau FIPS county code and the precinct number. Election results, however, are reported using
precinct numbers that contain county codes assigned by the Colorado Secretary of State. These county codes are different from the FIPS county codes. To make the files compatible, the 64 individual precinct identifiers were modified using the ArcGIS Pro Calculate Field tool and the Python 3 replace function. The three-digit FIPS county code was replaced with the two-digit county number assigned by the Secretary of State. Accurate county codes were derived from precinct numbers obtained from the Colorado Secretary of State election results website. Colorado precinct numbers are made up of 10 digits with the sixth and seventh digits being the assigned county number (Colorado Secretary of State, n.d.-b). The resulting five-digit county number plus precinct number is compatible for later joining with election results. After modification, the individual files were merged in ArcGIS Pro into one shapefile for the entire state containing 3108 precincts. This precinct shapefile was then spatially joined with the census blocks file to add demographic data to the precincts.

**Colorado 2018 Election Results**

This research looks at down-ballot races as a measure of overall partisanship. Down-ballot races are those where the candidates are not well known, and the office sought is not a major office such as the governorship. Down-ballot races identify true partisan voting because the vote cast is generally for a party, not necessarily the candidate running (Krasno, Magleby, McDonald, Donahue, & Best, 2018). For this research, the three down-ballot races selected were Attorney General, Secretary of State, and Treasurer. These races were contested state-wide and resulted in good data coverage for the state. Other down-ballot races, such as Regent, were ruled out due to missing data—not every race was contested across the state—or relative obscurity. The down-ballot
races selected represent offices that voters likely recognize as important enough to cast a vote for but are unlikely to know much about the actual candidates running (Krasno et al., 2018).

Election results are reported by the Colorado Secretary of State. This research looked at the most recent results from the 2018 midterm election. This data was chosen for its recency and because it is the fourth congressional election cycle under the current district map. This allows for a longer evaluation of what impact the current map has had on election outcomes. Precinct-level results for the 2018 general election were downloaded from the Secretary of State website. The data was sorted by Office/Issue/Judgeship in order to separate out the races of interest since this research is not concerned with every race for which election results were reported. Congressional races and three down-ballot races were selected for further processing. The resulting data was then sorted by party to winnow it down to just Republican and Democrat. Other parties were excluded from this research to match the hypothetical two-party race methodology described in the literature review and due to their role as primarily spoilers for one of the two major parties. Including third parties in this analysis would obscure rather than clarify broader patterns that this research seeks to identify, so they were removed from consideration. The single party data was then sorted by office to arrive at results of individual races for each party. The 10-digit precinct number was shortened to a five-digit number containing only county and precinct numbers to be compatible for joining with existing precinct and census data. Finally, individual races were combined into a single table matched by precinct number and joined in ArcGIS Pro with the
existing precinct and census data shapefile. Eighteen precincts reported no votes cast and are listed in Table 5.

Table 5

*Colorado Precincts Reporting No Votes Cast 2018*

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<thead>
<tr>
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<td>Adams 220</td>
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<td>Adams 223</td>
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<tr>
<td>Arapahoe 458</td>
<td>Arapahoe 561</td>
<td>Weld 315</td>
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</tbody>
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*Other Publicly Available Data*

The remaining data used in this research are publicly available administrative area shapefiles. A district shapefile for the 115th congress was downloaded from the U.S. Census Bureau website. These congressional districts are also known as the Moreno/South map and that shapefile can be found at the Colorado redistricting website under current maps. A Colorado counties shapefile was downloaded from the Colorado Department of Health and Environment but is also available from the U.S. Census Bureau and from GIS companies such as Environmental Systems Research Institute (Esri). Table 6 outlines the primary data used in this research.
Table 6

Primary Data Sources

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<th>Data</th>
<th>Location</th>
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</thead>
<tbody>
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<td>“Blocks” - 2010 census blocks with demographic data</td>
<td><a href="https://demography.dola.colorado.gov/gis/gis-data/#gis-data">https://demography.dola.colorado.gov/gis/gis-data/#gis-data</a></td>
</tr>
<tr>
<td>State Demography Office</td>
<td>Precinct shapefiles for 64 counties</td>
<td>Contact Colorado Department of Local Affairs for link to file location 1-303-864-7720</td>
</tr>
<tr>
<td>Secretary of State Election Results</td>
<td>Colorado 2018 precinct-level election results</td>
<td><a href="https://www.sos.state.co.us/pubs/elections/Results/Archives.html">https://www.sos.state.co.us/pubs/elections/Results/Archives.html</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Also available as Moreno/South from <a href="https://redistricting.colorado.gov/proposed-congressional-maps">https://redistricting.colorado.gov/proposed-congressional-maps</a></td>
</tr>
<tr>
<td>Department of Health and Environment</td>
<td>Colorado counties shapefile</td>
<td><a href="https://data-cdphe.opendata.arcgis.com/datasets/66c2642209684b90af84afcc559a5a02_5/data">https://data-cdphe.opendata.arcgis.com/datasets/66c2642209684b90af84afcc559a5a02_5/data</a></td>
</tr>
</tbody>
</table>

Methodology

Once the precinct shapefile is joined with census demographics and 2018 election results, the combined attribute table can be used to derive any number of metrics. For this research, three down-ballot election raw counts were converted to percentages by precinct between the two major parties. That is, for each precinct in the state the share of Republican and Democratic votes was calculated by dividing one party’s vote share by the total vote count for both parties. The average state-wide win percentage for each of the three races was calculated and the Treasurer’s race found to match the average almost
exactly. As such, this research will use the Treasurer’s race as a surrogate for partisan voting state-wide. Table 7 shows the breakdown of the three races.

Table 7

Select Colorado Down-ballot Win Percentages

<table>
<thead>
<tr>
<th>Race</th>
<th>Republican</th>
<th>Democrat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attorney General</td>
<td>.46969</td>
<td>.53031</td>
</tr>
<tr>
<td>Secretary of State</td>
<td>.46059</td>
<td>.53941</td>
</tr>
<tr>
<td>Treasurer</td>
<td><strong>.46551</strong></td>
<td><strong>.53449</strong></td>
</tr>
<tr>
<td>Average</td>
<td><strong>.46526</strong></td>
<td><strong>.53474</strong></td>
</tr>
</tbody>
</table>

*Note.* Average down-ballot percentage and race most closely matching it are in boldface.

**Partisan Index**

To attain competitive districts as this research seeks, it is necessary to know where partisan voters are located and in what numbers. Having identified the Treasurer’s race as the most representative of down-ballot races, a partisan index was constructed by subtracting Republican percent win from Democrat percent win in each precinct. The resulting index ranges from -1 to +1 where -1 means that the Republican candidate won 100% of the votes in that precinct and a +1 means that the Democratic candidate won 100% of the votes. For example, if the Republican candidate won 75% of the vote and the Democratic candidate won the remaining 25%, the index would be .25 - .75 = -.5. The resulting value represents the percentage difference between the two parties in that precinct. In the previous example, there is a 50% difference between Democrat and Republican represented by the -.5 index value. The negative sign in the example indicates that the vote advantage is for the Republican candidate. A positive sign would indicate a
Democratic advantage. A state-wide map of partisan index by precinct was constructed for Colorado to serve as a visual decision-making guide for constructing competitive districts and can be found in the results section (Figures 4 and 5).

**Population Density**

To construct competitive congressional districts of equal population, knowledge of Colorado’s population distribution is also required. The partisan index provides information about how a precinct votes with regard to the two major parties but does not provide useful information about their numbers. This shortcoming is remedied by computing population density for the state. A population density map by precinct was constructed to provide a visual representation of the magnitude of population disparities between various regions in Colorado and can be found in the results section (Figure 7). This is necessary to guide the selection of counties and precincts when building competitive congressional districts.

**Null Hypothesis**

With partisanship and population density mapped, the next question is how the data is spatially distributed across the state. The null hypothesis is that the spatial data under consideration is distributed as complete spatial randomness (CSR). That is, there are no processes at work that influence where the data might be located. It is as if the data were tossed haphazardly across geographic space, coming to rest in random positions. Population density is known to be higher in urban areas than in rural ones, almost by definition, and the previously discussed population density map calculated and mapped that data. Therefore, testing for CSR in the population data offers little new knowledge about its distribution—it is not randomly distributed. How voting preference is
distributed across the state, however, is unknown and an analysis of that distribution is desired. As such, the percent Republican win in the representative 2018 Treasurer’s race was evaluated using the Global Moran’s I tool in ArcGIS Pro. The tool could also have been run on the percent Democrat win as those results are merely the inverse of the Republican win in a two-party race.

**Global Moran’s I Test for Spatial Autocorrelation**

Global Moran’s I tests the assumption of random spatial distribution by looking for spatial autocorrelation. Spatial autocorrelation is a common characteristic in geographic inquiry and refers to the fact that “data from locations near one another in space are more likely to be similar than data from locations remote from one another” (O’Sullivan & Unwin, 2010, p. 34). This fact negates many conventional statistical techniques that rely on the random distribution of data from which a representative sample can be taken. Spatial autocorrelation causes data redundancy which means that a smaller amount of new information is gained by each additional data item and therefore conclusions based on a normal sample size probably do not hold (O’Sullivan & Unwin, 2010). Global Moran’s I evaluates feature values and locations together and determines how the data is distributed: randomly, clustered, or dispersed (Esri, n.d.-b). To check for the presence of spatial autocorrelation, the Global Moran’s I tool was run on Republican win percent in the 2018 Treasurer’s race.

**Local Moran’s I Cluster and Outlier Analysis**

Identifying partisan voting patterns is useful for later decision-making when constructing congressional districts. Global Moran’s I verifies whether or not spatial autocorrelation is present in a data set but does not provide useful information about
where clusters or outliers, if they exist, are located (Dao, 2019). The Anselin Local Moran’s I tool solves this problem by identifying spatial clusters and outliers in features. To evaluate the spatial distribution of partisan voting in Colorado, the tool was run on Republican win percent in the 2018 Treasurer’s race. Anselin Local Moran’s I cluster and outlier analysis tool is appropriate for this research because it returns a map of statistically significant clusters and outliers that reveal where partisan voters are located. Together with population density, this information is crucial for constructing competitive districts as it provides a visual representation of partisan voting patterns across the state.

As with Global Moran’s I, the null hypothesis is that data is distributed randomly across space. When nonrandom clustering is detected, it is identified with the cluster type, high-high or low-low. For this analysis a high-high cluster type indicates that the Republican win percentage is high and statistically significant in precincts located near one another. A low-low cluster type indicates that the Republican win percentage is low and statistically significant in precincts located near one another. Outliers are identified as high-low when a low value is located near a high cluster or as low-high when a high value is located near a low cluster. These outliers are accompanied by high negative z-scores. The final cluster/outlier type is labeled not significant and is accompanied by z-scores that represent a random distribution. The output from the tool is a map of clusters and outliers with an associated attribute table of values from the operation.

Create Competitive District Maps

Since creating competitive districts requires knowledge of population and partisan voting patterns, the methodology up to this point has been geared toward understanding the spatial distribution of those attributes for Colorado. The next step is to use that
information to guide the decision-making process involved in creating competitive
districts. Since the research question involves evaluating the impact competitive districts
will have on keeping political subdivisions intact and measures of compactness, two
different district building approaches were used and two different district maps were
created (Figures 10 and 11). The impact of competitive district construction was
measured from the resulting maps. The goal of the first approach was to make
competitive districts while minimizing county splits. A focus on these two criteria
permits an examination of the impact on compactness scores. The goal of the second
attempt ignored county splits and focused on making competitive districts as compact as
possible. A focus on these two criteria permits an examination of the impact on county
splits.

The two experimental maps were created manually using ArcGIS Pro. No
algorithmic computer searches were employed in this research and the terms minimize
and maximize refer to a human decision-making process, not an automated one.
Judgements were made about which precincts to include in a district based on the purpose
of that experimental competitive map, minimizing county splits or maximizing
compactness. The data used to create the two experimental maps were the state-wide
precinct shapefile spatially joined with 2010 census blocks containing SF1 demographic
information. Election data from the representative Treasurer’s race in 2018 was then
joined with the precinct and census data. The partisan index previously described was
computed and added to the data set. The resulting feature class from this joining process
included total population, election results, and partisan index by precinct for all of
Colorado. The partisan index and population in this data set guided the selection of counties and/or precincts in creating the competitive experimental maps.

The process of creating congressional districts began by focusing on the competitive map’s secondary purpose of either minimizing county splits or maximizing compactness. Then the existing population and partisan patterns were evaluated and initial decisions were made regarding the best combinations of counties and/or precincts to accomplish the desired goal. For both maps, an iterative process of selecting counties and/or precincts and then evaluating the resulting partisan index mean and cumulative population with the ArcGIS Pro statistics function was employed. Counties and/or precincts were combined in an effort to attain a partisan index mean between -.1 and .1 that indicate a competitive race within 10%. Cumulative population was monitored with the goal of attaining the ideal population of 718,457. Since exact ideal population is unattainable in most cases, it was decided to attempt to attain the ideal population within .1% of the ideal population, or within 718 of ideal population. This is an aggressive goal given that the mean precinct population is 1,618 so that the addition or exclusion of a single precinct may be larger than the allowed margin. The maximum deviation from ideal population for this research was .08% and the average deviation for both experimental maps was .03%. For districts that could be made competitive, the iterative process stopped when the partisan index indicated a competitive race within 10% and the proposed district population was within ± .1% of the ideal population. Where competitive districts were not possible, the iterative process stopped when the proposed district population was within ± .1% of the ideal population.
The grouping analysis functionality within ArcGIS Pro (e.g., spatial statistics tools—mapping clusters—build balanced zones) was not applicable to this research for the following reasons. First, the tool was unable to create districts with a total population that met the strict equal population requirement of ± .1% of the ideal population. Ten attempts yielded unacceptable final populations for the districts and three returned less than the required seven districts. These unacceptable results are likely related to the nonrandom distribution of both population and partisan voters as will be described in the results section. Second, the districts that were created using the group analysis tool did not produce districts that were both visually and mathematically compact as this research desired. Boundaries between districts often included protrusions of one district into another that satisfied the algorithm’s compactness selection process but made the overall districts less compact than a manual process would have. Finally, to make the group analysis tool perform better for Colorado would require adjusting how the algorithm selected a starting population and how it grew the districts to account for population and partisanship disparities between geographic areas. This goes against a key principle of this research which is to use unsophisticated techniques and procedures. Manipulating or rewriting computer code, as may be required to adjust the algorithm to Colorado’s unique characteristics, is also beyond the scope of this research. This research employs a human decision-making process, not an automated one, and a thorough literature review of automated redistricting was not conducted. Computer redistricting is a robust and growing field and the interested reader would find ample material in the literature by using the search terms redistricting and computer.
**Competitive Districts Minimizing County Splits.** For the first approach, the ArcGIS Pro Dissolve tool was used to aggregate existing precinct-level demographic and election results data by county. This allowed for a rough organization of counties by population and partisan voting patterns. The goal was to keep counties intact as much as possible while balancing population between seven districts and combining partisan voting patterns in such a way as to create competitive districts. Population totals and the average partisan index guided selection. Due to a vote imbalance of 178,424 in favor of Democrats, it was obvious from the start that at least one district would be heavily Democratic. In order to allow more competitive districts to be drawn elsewhere, Denver County was kept intact from the start to help offset its very high population density and highly Democratic partisanship. Due to high population and high Republican partisanship, it was also apparent from the outset that El Paso County, unless it were split, would be the core of a noncompetitive Republican district. Also, the heavily Republican-leaning counties to the southeast would be nearly impossible to join with Democratic-leaning ones to create a competitive district due to the contiguity constraint. As such, El Paso County and the area to the southeast were conceded as a noncompetitive Republican district. The remaining counties were grouped together based on population and partisan index. The goal was districts with an overall partisan index between -.1 and +.1 which indicates an electoral race within a 10% win margin.

**Competitive Districts Maximizing Compactness.** The second approach ignored county splits and focused instead on creating competitive districts with compact shapes. The Local Moran’s I, partisan index, and population density maps guided this method. Denver’s high population density and Democratic preference once again presented
difficulties for drawing competitive districts. As before, Denver was conceded as a Democratic stronghold in order to make competitive districts available throughout the rest of the state. The starting point for this attempt was to create a compact shape that encompassed the bulk of the heavily Democratic Denver-Boulder area. This was necessary due to the location of Democratic partisans to the west of Denver along I-70. Without removing some of the very Democratic voters in the Boulder area it would be nearly impossible to craft competitive districts west of Denver. After that, the method combined heavily Republican partisan voters in sparsely populated areas with Democratic partisans near the urban core. Due to the enormous population density disparities between Republican rural areas and Democratic urban ones, a guiding assumption was that rural areas would need to reach back toward the greater Denver area to gather voters that would result in more competitive districts.

Measure the Impact of Competitive Districts

The final step in the process was to answer the research question: what impact will drawing competitive congressional districts have on measures of compactness and political subdivision preservation? Minimizing the total perimeter of district boundaries is called for by the Colorado Constitution and that measure along with Schwartzberg compactness scores are readily computed for comparison. As such, both total perimeter miles and Schwartzberg compactness scores were calculated for existing congressional districts and for each of the proposed districting schemes. County splits were counted in the existing congressional districting scheme and in each of the proposed districting schemes. County splits were counted as the total number of polygons belonging to a county. An unsplit county is equal to one polygon. If the county is split such that its
original borders encompass additional shapes, those additional polygons represent splits. For example, imagine a square as one polygon. Now draw any line in or across the square so that the original square now contains an additional shape within it or has been divided in some way. Those additional shapes represent splits. Subtract the original number of polygons, one, from the total number of shapes or polygons that now make up the square and you arrive at the number of splits. An alternate approach is to visually inspect counties for how many different districts they belong to. An unsplit county belongs to a single district. If parts of Denver County belong to three separate districts rather than one, it has been split two times: three districts minus the one district it would belong to if unsplit equals two splits.
CHAPTER IV
RESULTS

Overview

The first part of the results section describes data derived from the joined datasets outlined in methodology. This data is important for understanding how Colorado is structured in terms of demographics and partisan voting patterns. 2010 U.S. Census data reveals that Colorado had a population of 5,029,196. Congressional apportionment for the state at that population is seven. That means that each congressional district should contain 5,029,196 divided by 7 districts, which is 718,456.6 or rounded up to 718,457 people per district. The 2018 election saw 2,381,342 votes cast for Treasurer between the two major parties with 1,279,883 cast for the Democratic candidate and 1,101,459 for the Republican candidate. That is a difference of 178,424 votes in favor of Democrats in this representative race. The percent votes cast for the Democratic candidate was 53.7% and for the Republican candidate was 46.3%. The resulting state-wide partisan index for this race is .074 which indicates a state-wide Democratic advantage if districts could be devised that contained equal proportions of this representative data. A map of the computed partisan index by precinct is presented in Figure 4 with an expanded view of the greater Denver metropolitan area following in Figure 5.
Figure 4

Map of Colorado Partisan Index by Precinct from 2018 Treasurer’s Race.
Population Density

Twelve precincts reported zero population on the 2010 census count. It is unclear if that is factual or a reporting error. For the remaining 3,096 precincts reporting population in 2010, results of the population density computation by precinct range from .04 to 36,929.82 people per square mile with a mean of 3424.25 and a median of 2755.25. The histogram in Figure 6 shows the population density distribution by precinct. A normal bell curve distribution is not present due to the very high number of precincts reporting low population densities. The left bin in the histogram represents 1,126
precincts out of a total of 3,108. These precincts make up the majority of Colorado’s physical area and are found almost exclusively in rural areas. On the population density map in Figure 7, these precincts surround all of the higher density areas identified with shades of red.

Figure 6

*Distribution of Colorado Population Density by Precinct.*

*Note.* The leftmost bin represents the high number (1,126) of rural precincts with below average population density.
Figure 7

*Colorado Population Density Symbolized with Jenks Natural Breaks.*

*Note.* The bulk of the state’s geographic area reports the lowest population density. The highest population density is centered on the Denver metropolitan area with additional clusters in major cities along I-25.

**Global Moran’s I Test for Spatial Autocorrelation**

To determine partisan voting spatial distribution, Republican percent win in the 2018 Treasurer’s race was evaluated using Global Moran’s I. That tool calculates the mean for values under consideration and then computes the deviation from the mean for those features. The deviation is calculated as feature value minus the mean such that attribute values larger than the mean result in positive deviations and attribute values
smaller than the mean result in negative values. Those deviations from the mean are then multiplied together such that positive values multiplied by positive values returns a positive value and negative values multiplied by negative values also return positive values. This means that a positive Moran’s I value indicates like values (larger than or smaller than the mean) are clumped together. Therefore, a positive Moran’s I indicates clustering while a negative Moran’s I indicates dispersed data (larger and smaller values are near each other compared to the mean) and a near-zero value indicates random distribution.

The p-value resulting from Global Moran’s I is the probability that the spatial pattern observed is completely random. A very small p-value indicates that there is a small probability that the pattern observed was created by a purely random process. This signifies a rejection of the null hypothesis of CSR and an implication that the data pattern is not random. A 95% confidence level corresponds to critical z-score values of -1.96 and +1.96 (approximately two standard deviations) and an uncorrected p-value of .05. This means that if the spatial autocorrelation report indicates a z-score between -1.96 and +1.96, the p-value will be larger than the desired .05 (95% confidence level) and the null hypothesis cannot be rejected. If, however, the spatial autocorrelation report indicates a z-score beyond -1.96 or +1.96, the p-value will be smaller than the required .05 (better than 95% confidence level) and the null hypothesis of spatial randomness can be rejected. Figure 8 illustrates the relationship between p-values and z-scores.
Global Moran’s I Results

Results from Global Moran’s I indicate that voter preferences are not randomly distributed across geographic space but are clustered. The tool was run five times using the following spatial conceptualizations: inverse distance, inverse distance squared, nearest neighbor with 10 neighbors, nearest neighbor with 100 neighbors, and contiguity with edges and corners. The results indicate that there is less than a 1% chance that the observed pattern is the result of CSR. All p-values indicate greater than 99% probability of spatial autocorrelation. Z-scores from the analysis are all well beyond three standard deviations from the mean. Consistently large and positive Moran’s index values indicate

that the Republican percent win is both clustered and quite far from the mean. Global
Moran’s I results are illustrated in Table 8.

Table 8

Global Moran’s I Republican Percent Win 2018 Treasurer’s Race by Precinct

<table>
<thead>
<tr>
<th>Spatial conceptualization</th>
<th>Moran’s index</th>
<th>Expected index</th>
<th>Variance</th>
<th>Z-score</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inverse distance</td>
<td>.539955</td>
<td>-.000324</td>
<td>.000012</td>
<td>153.211508</td>
<td>.000000</td>
</tr>
<tr>
<td>Inverse distance squared</td>
<td>.713296</td>
<td>-.000324</td>
<td>.000038</td>
<td>115.745139</td>
<td>.000000</td>
</tr>
<tr>
<td>10 nearest neighbors</td>
<td>.829692</td>
<td>-.000324</td>
<td>.000057</td>
<td>109.713158</td>
<td>.000000</td>
</tr>
<tr>
<td>100 nearest neighbors</td>
<td>.632879</td>
<td>-.000324</td>
<td>.000005</td>
<td>272.268900</td>
<td>.000000</td>
</tr>
<tr>
<td>Contiguity edges corners</td>
<td>.884984</td>
<td>-.000324</td>
<td>.000110</td>
<td>84.370225</td>
<td>.000000</td>
</tr>
</tbody>
</table>

Local Moran’s I Cluster and Outlier Analysis

The Anselin Local Moran’s I tool was run on Republican percent win in the 2018 Treasurer’s race. It returns a Moran’s I index, a cluster/outlier type, pseudo p-values, and a z-score. The Moran index itself is a relative metric that should be interpreted along with p-values and z-scores (Esri, n.d.-a). Positive values of the index mean that a feature’s neighbors have similarly high or low values and thus make up a cluster. Negative index values mean that neighboring features have dissimilar values and indicates a particular feature is an outlier (Esri, n.d.-a). The p-value represents statistical significance of these clusters and outliers. P-values represent the probability that an observed spatial distribution is the result of CSR. As such, p-values indicate statistical significance and whether or not the null hypothesis should be rejected. The z-score, or standard score, represents standard deviation and indicates how far from the mean a value is in the data set. Taken together, p-values and z-scores illustrate where data lies in relation to a normal
distribution in the familiar bell curve. The p-values represent the area under the curve for
a distribution and, assuming a 95% confidence level, values less than .05 indicate
statistical significance. Statistically significant p-values indicate that the null hypothesis
can be rejected.

**Local Moran’s I Results**

For this analysis, 3,090 values were reported in the resulting attribute table for the
new feature class which is the original 3,108 precincts minus 18 precincts reporting no
election data (refer to Table 5). P-values range from .001 to .499 with a mean of .025, a
median of .001, and a standard deviation of .081. Z-scores range from -27.378 to 31.494
with a mean of 6.409, a median of 5.426, and a standard deviation of 10.216. Moran’s I
index values range from -.852 to 4.891 with a mean of .540 and a median of .259. For
this data set the not significant z-scores range from -1.69 to 1.70 or approximately 1.7
standard deviations from the mean. Since the Moran’s index value is relative, it is
excluded from the table outlining the results from the Local Moran’s I tool. Z-scores and
p-values for the Local Moran’s I calculations are displayed in Table 9.

**Table 9**

*Local Moran’s I Republican Percent Win 2018 Treasurer’s Race by Precinct*

<table>
<thead>
<tr>
<th>Cluster/outlier type</th>
<th>Z-score range</th>
<th>Z-score mean</th>
<th>P-value range</th>
<th>P-value mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-High</td>
<td>1.64 to 16.66</td>
<td>6.08</td>
<td>.001 to .049</td>
<td>.003</td>
</tr>
<tr>
<td>High-Low</td>
<td>-27.38 to -1.66</td>
<td>-8.60</td>
<td>.001 to .046</td>
<td>.002</td>
</tr>
<tr>
<td>Low-High</td>
<td>-7.16 to -1.67</td>
<td>-3.94</td>
<td>.001 to .043</td>
<td>.004</td>
</tr>
<tr>
<td>Low-Low</td>
<td>1.64 to 31.49</td>
<td>14.18</td>
<td>.001 to .046</td>
<td>.002</td>
</tr>
<tr>
<td>Not Significant</td>
<td>-1.69 to 1.70</td>
<td>.17</td>
<td>.051 to .499</td>
<td>.235</td>
</tr>
</tbody>
</table>

*Local Moran’s I Results by Cluster/Outlier Type*
To better understand the data produced from the Local Moran’s I tool, the resulting attribute table from the analysis was sorted by cluster/outlier types and then those types were selected individually and exported to their own feature class. That new cluster or outlier feature class was used to select demographic data from the existing feature class with census, precinct and election data. That data was then exported to a new feature class so that demographic and election information was combined with each cluster and outlier. Table 10 summarizes some of the demographics and electoral characteristics of the resulting cluster/outlier analysis.

Table 10

*Local Moran’s I Republican Percent Win 2018 Treasurer’s Race by Type*

<table>
<thead>
<tr>
<th>Cluster/outlier type</th>
<th>Population</th>
<th>Precincts</th>
<th>GOP mean</th>
<th>Partisan index</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Republican clusters/outliers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High High</td>
<td>1,160,289</td>
<td>716</td>
<td>.69</td>
<td>-.38</td>
</tr>
<tr>
<td>High Low</td>
<td>826,347</td>
<td>563</td>
<td>.56</td>
<td>-.12</td>
</tr>
<tr>
<td>Totals</td>
<td>1,986,636</td>
<td>1,279</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Democrat clusters/outliers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Low</td>
<td>2,425,243</td>
<td>1440</td>
<td>.31</td>
<td>.38</td>
</tr>
<tr>
<td>Low High</td>
<td>161,526</td>
<td>60</td>
<td>.39</td>
<td>.22</td>
</tr>
<tr>
<td>Totals</td>
<td>2,586,769</td>
<td>1,500</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>No clusters/outliers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not significant</td>
<td>429,499</td>
<td>298</td>
<td>.53</td>
<td>-.06</td>
</tr>
</tbody>
</table>

*Note.* Total population for clusters is shown in boldface. High-high cluster is high Republican win percent while low-low cluster is low Republican win percent (or high Democratic win percent) in 2018 Treasurer’s race.

*Local Moran’s I Map and Interpretation*
Since the analysis tool was run on Republican percent win, high-high clusters represent high Republican partisan voters while low-low clusters represent high Democratic partisan voters. The high-low outliers signify high Republican vote numbers surrounded by low Republican vote numbers (or high Democratic vote numbers) as is the case around Denver. For map interpretation, red indicates Republican preference and blue indicates Democratic preference. Local Moran’s I analysis reveals three major clusters of partisan voters. The eastern third of the state is highly Republican as is much of the western quarter. A swath of the state focused on Denver and Boulder and then spreading southwest toward Aspen along and south of I-70 is a high Democratic cluster. The remainder of the state is statistically insignificant regarding clusters of partisan voters or is the transition area between the other very partisan groups. Figure 9 maps the results.

Local Moran’s I Cluster/Outlier Type with Population Density

While the cluster/outlier analysis is revealing by itself, constructing equal population competitive districts also requires information about the population associated with those clusters. Population density along with average partisan voting percentages and partisan index by cluster type was calculated. The results shown in Table 11 indicate that the high-high and high-low cluster/outlier types associated with Republican partisans have the lowest population density while the clusters/outliers associated with Democratic partisans have the highest.
Figure 9

Map of Local Moran’s I Cluster Analysis for Colorado.

Note. The high-high clusters (light red) and high-low outliers (dark red) represent Republican voters. The low-low clusters (light blue) and low-high outliers (dark blue) represent Democratic voters. No color represents no significant clustering.

Table 11

Local Moran’s I with Population Density

<table>
<thead>
<tr>
<th>Cluster/outlier</th>
<th>Precincts</th>
<th>Population density</th>
<th>DEM %</th>
<th>GOP %</th>
<th>Partisan index</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-High</td>
<td>717</td>
<td>1,521.07</td>
<td>.311</td>
<td>.689</td>
<td>-.378</td>
</tr>
<tr>
<td>High-Low</td>
<td>565</td>
<td>2,556.48</td>
<td>.442</td>
<td>.558</td>
<td>-.116</td>
</tr>
<tr>
<td>Low-High</td>
<td>60</td>
<td>4,068.44</td>
<td>.610</td>
<td>.390</td>
<td>.220</td>
</tr>
<tr>
<td>Low-Low</td>
<td>1,445</td>
<td>5,174.15</td>
<td>.692</td>
<td>.308</td>
<td>.384</td>
</tr>
<tr>
<td>Not Significant</td>
<td>303</td>
<td>1,367.31</td>
<td>.469</td>
<td>.531</td>
<td>-.062</td>
</tr>
</tbody>
</table>
Measuring the Impact of Competitive Districts

The research problem is that Colorado’s new competitive criterion will likely conflict with other districting criteria depending on what choices are made with regard to implementation. Prioritizing one criterion over others can impact the others to varying degrees. The research question is what impact will drawing competitive congressional districts have on measures of compactness and political subdivision preservation? In order to determine what those impacts may be, this research prioritizes competitive districts over political subdivision splits and compactness in the creation of congressional districts in order to measure these impacts. To determine what changes in compactness or county splits have occurred, measures of compactness and political subdivision splits for existing congressional districts are required for comparison.

Existing Congressional Districts Measures

Existing congressional district measurements come from the U.S. Census Bureau 115th congress shapefile. Partisan indices were computed from 2018 district-wide congressional election results as reported by The Washington Post (“Colorado Election Results,” n.d.). Results were converted to a two-party race by tallying votes for just the two major parties and then computing percent win from that total. The state-wide partisan index average is .101 which indicates a Democratic-leaning electorate overall. However, the absolute average which computes the magnitude of partisanship without the sign indicating political preference is .238. This indicates that the existing congressional districts are constructed in a way that makes them more partisan than the state as a whole.
These are not competitive districts overall. The existing congressional districting scheme contains 11 split counties. Table 12 lists the existing congressional district characteristics.

Table 12

*Existing District Characteristics from 2018 Congressional Race*

<table>
<thead>
<tr>
<th>District</th>
<th>Area square miles</th>
<th>Perimeter miles</th>
<th>Schwartzberg</th>
<th>Partisan index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>192.68</td>
<td>156.69</td>
<td>.314</td>
<td>.524</td>
</tr>
<tr>
<td>2</td>
<td>7,628.68</td>
<td>649.72</td>
<td>.477</td>
<td>.284</td>
</tr>
<tr>
<td>3</td>
<td>49,896.22</td>
<td>1,329.61</td>
<td>.596</td>
<td>-.084</td>
</tr>
<tr>
<td>4</td>
<td>38,283.29</td>
<td>1,139.14</td>
<td>.609</td>
<td>-.212</td>
</tr>
<tr>
<td>5</td>
<td>7,288.84</td>
<td>478.71</td>
<td>.632</td>
<td>-.184</td>
</tr>
<tr>
<td>6</td>
<td>482.52</td>
<td>225.95</td>
<td>.345</td>
<td>.116</td>
</tr>
<tr>
<td>7</td>
<td>351.88</td>
<td>174.05</td>
<td>.382</td>
<td>.261</td>
</tr>
<tr>
<td>Totals</td>
<td>104,124.11</td>
<td>4,153.88</td>
<td>Mean = .479</td>
<td>Mean = .101</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Absolute = .238</td>
<td></td>
</tr>
</tbody>
</table>

Note. Schwartzberg compactness scores below the mean are shown in boldface. Partisan indices larger than the absolute mean are shown in boldface.

**Minimizing County Splits Measures**

The first build attempt focused on creating competitive districts while keeping counties intact. The newly created congressional district boundary perimeters ranged from 159.71 miles to 1,103.10 miles with a total of 4,258.28 miles for all seven districts. Schwartzberg scores were calculated and ranged from .300 to .737 with an average of .550. Partisan indices range from -.267 to .529 with an average of .072 and an absolute value (disregarding the partisan preference sign) of .177. Seven counties were split in the effort. As expected, the decision to keep Denver County intact to diminish some of the 178,424 Democratic vote advantage in the state resulted in the highest partisan index.
That decision also resulted in the worst compactness score of .300 due to Denver’s elongated and irregular shape. Recall that El Paso County was also conceded as the foundation of a noncompetitive district due to its high population and high Republican partisanship. It was combined with counties to the southeast which, due to contiguity constraints, could not be joined with offsetting Democratic partisans to create a competitive district. One additional district was unable to attain a competitive partisan index, but four districts produced a partisan index indicative of competitive races within 10%. Results from the first build attempt are in Table 13. A congressional district map from this attempt is included as Figure 10.

Table 13

<table>
<thead>
<tr>
<th>District</th>
<th>Area square miles</th>
<th>Perimeter miles</th>
<th>Schwarzberg</th>
<th>Partisan index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>182.18</td>
<td>159.71</td>
<td>.300</td>
<td>.529</td>
</tr>
<tr>
<td>2</td>
<td>1,487.94</td>
<td>286.99</td>
<td>.476</td>
<td>.267</td>
</tr>
<tr>
<td>3</td>
<td>30,035.15</td>
<td>947.89</td>
<td>.648</td>
<td>-.041</td>
</tr>
<tr>
<td>4</td>
<td>32,795.73</td>
<td>1,103.10</td>
<td>.582</td>
<td>-.057</td>
</tr>
<tr>
<td>5</td>
<td>23,941.60</td>
<td>744.51</td>
<td>.737</td>
<td>-.267</td>
</tr>
<tr>
<td>6</td>
<td>13,483.32</td>
<td>698.31</td>
<td>.589</td>
<td>.040</td>
</tr>
<tr>
<td>7</td>
<td>2,168.57</td>
<td>317.78</td>
<td>.519</td>
<td>.035</td>
</tr>
<tr>
<td>Totals</td>
<td>104,094.49</td>
<td>4,258.28</td>
<td>Mean = .550</td>
<td>Mean = .072</td>
</tr>
</tbody>
</table>

Note. Schwartzberg compactness scores below the mean are shown in boldface. Partisan indices larger than the absolute mean are shown in boldface.
Note. Denver and El Paso Counties are the core of two noncompetitive partisan districts, Democratic (District 1) and Republican (District 5) respectively. An additional noncompetitive district encompassing most of Boulder and Jefferson Counties (District 2) was unavoidable due to geographic constraints. The four remaining districts are competitive.

**Maximizing Compactness Measures**

The second build attempt sought to create competitive districts that were also compact. No concern was given to county splits whatsoever. Since Democratic votes outnumbered Republican votes in the Treasurer’s race by 178,424, it was necessary once again to try to offset that partisan advantage in order to create the maximum number of
competitive districts in the rest of the state. As such, District 1, which encompasses much of the Denver-Boulder area, resulted in an uncompetitive partisan index of .472. This early concession, however, allowed for six other districts to be constructed with partisan indices indicating a competitive race within 10%. Of those, all but one were .060 or less which indicates a very competitive race. This attempt resulted in 23 county splits. Results from the second attempt are presented in Table 14. Figure 11 is a map of congressional districts from the second attempt.

Table 14

<table>
<thead>
<tr>
<th>District</th>
<th>Area square miles</th>
<th>Perimeter miles</th>
<th>Schwarzberg</th>
<th>Partisan Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>278.65</td>
<td>127.68</td>
<td>.463</td>
<td>.472</td>
</tr>
<tr>
<td>2</td>
<td>11,994.11</td>
<td>555.49</td>
<td>.699</td>
<td>-.023</td>
</tr>
<tr>
<td>3</td>
<td>11,326.23</td>
<td>572.59</td>
<td>.659</td>
<td>.057</td>
</tr>
<tr>
<td>4</td>
<td>915.89</td>
<td>191.29</td>
<td>.561</td>
<td>.056</td>
</tr>
<tr>
<td>5</td>
<td>20,607.11</td>
<td>690.24</td>
<td>.737</td>
<td>-.094</td>
</tr>
<tr>
<td>6</td>
<td>25,834.50</td>
<td>856.06</td>
<td>.666</td>
<td>.060</td>
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<tr>
<td>7</td>
<td>33,137.99</td>
<td>906.31</td>
<td>.712</td>
<td>-.020</td>
</tr>
<tr>
<td>Totals</td>
<td>104,094.48</td>
<td>3,899.66</td>
<td>Mean = .642</td>
<td>Mean = .070</td>
</tr>
</tbody>
</table>

| Absolute = .112 |

Note. Schwartzberg compactness scores below the mean are shown in boldface. Partisan indices larger than the absolute mean are shown in boldface.
Figure 11

*Competitive Districts Maximizing Compactness.*

*Note.* District 1 encompassing the highest population density parts of Denver and Boulder Counties was conceded as a noncompetitive Democratic district to enable competitive districts throughout the rest of the state. The remaining six districts are competitive within 10% and 23 counties were split in the effort.
CHAPTER V
DISCUSSION

The discussion that follows is geared toward informing the redistricting commission in accomplishing its task following the 2020 census count, reapportionment, and subsequent redistricting. Colorado’s demographic and electoral situation matches many other states across the country where higher population urban areas vote Democratic and lower population rural areas vote Republican. This high concentration of Democratic voters is inefficient from an electoral perspective—many Democratic votes are wasted in a single district to elect the candidate of their choice (Goedert, 2014). Wasted votes refer to those votes above and beyond what is necessary to elect a candidate of choice. Republican voters, on the other hand, are less concentrated in geographic space and, as a result, can more efficiently elect a candidate of choice by wasting fewer votes. Much of the research on the impact of population distribution on electoral outcomes comes from gerrymandering studies, which is not the purpose of this research. Recall that gerrymandering is the manipulation of district boundaries for the purpose of partisan political advantage. The implications of those studies, however, are applicable to the creation of competitive congressional districts in Colorado. This is because the “disadvantageous distribution of Democratic voters” means that it is difficult to separate out just the right amount of urban Democratic voters to combine with rural Republican voters to create competitive districts (Chen & Rodden, 2013, p. 240). This is particularly true when simultaneously adhering to other districting principles such as contiguity, compactness, and keeping political subdivisions intact.

Partisanship and Population Density
The partisan and population density maps illustrate why seven equally competitive congressional districts cannot be drawn. That reason is the nonrandom distribution of partisan voters and very different population densities among those partisan groups. The partisan index map shows a very large geographic area of Republican partisans, but the population density map reveals that those partisans are located in less populated areas. Likewise, the partisan index map shows a much smaller geographic area of Democratic partisans, but the population density map reveals that those partisans are located in highly populated areas. This explains why the partisan index map of Colorado seems to suggest a very Republican-leaning state overall, yet Democratic votes in the 2018 Treasurer’s race outnumbered Republican votes by 178,424. It should be noted that in spite of this higher Democratic vote count in the 2018 Treasurer’s race, the general trend in congressional elections until 2018 has been more Republican votes by an average of 50,650 votes or 2.3% of total votes cast. If the 2018 election is included, however, Democratic votes outnumber Republican votes by an average of 27,873 votes or 1.2% of total votes cast. This average vote count in favor of Democrats is based solely on the increased number of votes from the 2018 election. Previous years do not indicate such an advantage.

**Global and Local Moran’s I**

Global Moran’s I revealed a greater than 99% probability that the Republican percent win data was spatially autocorrelated. That means that it is clustered rather than randomly distributed across geographic space. Local Moran’s I mapped those clusters and outliers, confirming much of what was evident from the partisan index map, but adding statistical significance at greater than 95% probability to the patterns identified.
The Local Moran’s I analysis is most enlightening when population density data is added to the outcome. The Low-Low clusters that represent Democratic partisanship are 3.4 times more densely populated than the corresponding High-High clusters that represent Republican partisanship. While the degree of partisanship between the two groups is nearly identical, the much higher population density of Democratic partisans means that a relatively small Democratic area offsets a much larger Republican area in the creation of competitive districts.

**Tradeoffs from Creating Competitive Districts**

The partisan index, population density, Global and Local Moran’s I maps and data collectively describe Colorado’s starting condition. This starting condition must be accounted for in the effort to create competitive districts and explains the tradeoffs necessary between competitive districts and measures of compactness and political subdivision splits. Those tradeoffs are revealed in the two efforts to create competitive districts while simultaneously attempting to make districts either compact or minimize county splits.

**Minimizing County Splits Tradeoffs**

The first attempt to create competitive districts while minimizing county splits resulted in fewer split counties and more competitive districts than the existing scheme, but only four competitive districts out of seven could be created. This suggests that one tradeoff is between number of competitive districts and number of county splits. A lower number of county splits may produce fewer competitive districts overall. Another tradeoff is that compactness scores were only slightly better than the existing districting scheme. Minimizing county splits may reduce overall compactness scores. This is
especially true for Denver County which has a poor compactness score to start with. If Denver County is kept intact, and there may be reasons to do so, then expect compactness scores to suffer. The partisan index mean improved to near the state-wide number of .074 (reference Overview section and Table 13) which indicates that an intense focus on creating competitive districts, even while minimizing county splits, can yield more competitive districts than the existing scheme. The absolute partisan index decreased from this effort as well which indicates that focusing on competitive districts may lower overall district partisanship. This is significant in light of the fact that only four competitive districts could be created under this scheme. In sum, the main tradeoffs from this effort to minimize county splits was a relatively small number of competitive districts and only a small improvement in compactness scores over the existing district map.

**Maximizing Compactness Tradeoffs**

The second attempt which sought to create competitive districts while simultaneously maximizing compactness scores resulted in different tradeoffs. Six districts out of seven were created with partisan indices indicating a competitive race within 10%. However, this result came at the expense of county splits more than doubling from the existing districting scheme and tripling over the first build attempt. This further illustrates the tradeoff between number of competitive districts and number of split counties. More competitive districts will likely result in more split counties. The partisan index mean and absolute magnitude improved over both the existing plan and the first attempt that minimized county splits. This is yet another result of the tradeoff between split counties and district competitiveness as the partisan index is a measure of that
competitiveness. Of interest here is the magnitude of that improvement over the build that minimized county splits. More county splits allow for more diverse voting groups to be brought together thus lowering the overall partisan score for the district. This effort which split more counties than either the existing plan or the first build effort resulted in the most competitive districts and the lowest partisan indices. Unsurprisingly given the focus for this effort, compactness scores improved over both the existing district plan and the minimal county splits attempt. Given that compactness and partisan scores improved, and the number of competitive districts was maximized, the true tradeoff from this build attempt was in split counties.

**Existing Congressional Districts**

Given what is known about Colorado’s starting condition and the tradeoffs discovered in the two district build efforts, it is revealing to examine Colorado’s existing congressional districts. Why are existing boundaries located where they are and what did the previous plan designers intend? Colorado’s existing congressional districts are neither uniformly compact nor particularly competitive. Schwartzberg compactness scores range from .314 to .632 with an average of .479. Districts 1, 6, and 7 in the Denver area have compactness scores below .4, all seemingly influenced by Denver County’s odd shape and an unwillingness to split that county. Three districts have partisan indices above the absolute mean and only one indicates a potentially competitive race within 10%. Since 2012 only one congressional district has changed party hands. District 6 switched from Republican to Democratic control in 2018. In all previous congressional elections under the existing district boundaries, only District 6 produced races where the two major party candidates were within 10% of each other. Although District 3 did not change party
hands, the congressional race there in 2018 was within 10% for the first time. This seems to be the result of a larger trend away from Republicans in 2018 as all Democratic districts increased their win margin and all Republican districts lost ground, with District 6 switching party control.

**Existing Districts Incompatible with Competitiveness Goal**

The 2018 congressional election saw an 11 point move away from Republican candidates from the 2016 election (average of Democratic margin increase and Republican margin decrease), yet only a single district changed hands. This means that the current congressional map, with the exception of District 6 which changed party, is largely immune from a 10% change in voter preference. This fact is incompatible with Colorado’s new requirement to draw competitive districts. Furthermore, the average win margin in 2018 was 23.8% and the average for the four congressional elections using the existing district map is 25.1%. These excessive win margins are also incompatible with the goal of competitive elections. Congressional election outcomes between the two major parties for the life of the existing congressional district map, 2012 through 2018, are presented in Table 15 (Colorado Secretary of State, n.d.-a). The winning party and margin of victory are listed by district for each election cycle.
Table 15

*Congressional Election Results Under Existing District Plan*

<table>
<thead>
<tr>
<th>District</th>
<th>Winner</th>
<th>Win %</th>
<th>Winner</th>
<th>Win %</th>
<th>Winner</th>
<th>Win %</th>
<th>Winner</th>
<th>Win %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D</td>
<td>52.4</td>
<td>D</td>
<td>42.0</td>
<td>D</td>
<td>38.9</td>
<td>D</td>
<td>43.6</td>
</tr>
<tr>
<td>2</td>
<td>D</td>
<td>28.4</td>
<td>D</td>
<td>21.0</td>
<td>D</td>
<td>13.5</td>
<td>D</td>
<td>18.1</td>
</tr>
<tr>
<td>3</td>
<td>R</td>
<td>8.4</td>
<td>R</td>
<td>15.0</td>
<td>R</td>
<td>23.8</td>
<td>R</td>
<td>12.9</td>
</tr>
<tr>
<td>4</td>
<td>R</td>
<td>21.2</td>
<td>R</td>
<td>33.5</td>
<td>R</td>
<td>37.8</td>
<td>R</td>
<td>22.8</td>
</tr>
<tr>
<td>5</td>
<td>R</td>
<td>18.4</td>
<td>R</td>
<td>33.7</td>
<td>R</td>
<td>19.6</td>
<td>R</td>
<td>100.0</td>
</tr>
<tr>
<td>6</td>
<td>D</td>
<td>11.6</td>
<td>R</td>
<td>8.9</td>
<td>R</td>
<td>9.4</td>
<td>R</td>
<td>2.2</td>
</tr>
<tr>
<td>7</td>
<td>D</td>
<td>26.1</td>
<td>D</td>
<td>16.2</td>
<td>D</td>
<td>10.1</td>
<td>D</td>
<td>13.5</td>
</tr>
<tr>
<td>Mean</td>
<td>23.8</td>
<td>Mean</td>
<td>24.3</td>
<td>Mean</td>
<td>21.9</td>
<td>Mean</td>
<td>30.5</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Districts that changed party control from previous election and races within 10% margin are in boldface. Only one district changed party control under the existing districting scheme. Average win margin for four election cycles is 25.1%.

*Results of Existing District Map*

While the actual intent of the current district map’s designers cannot be fully known, the results are. The existing map, Figure 12, has delivered extremely safe seats in six of the seven districts since its implementation. The safe Democratic districts are as follows. District 1 is Denver and is too highly populated with Democratic partisans to ever change hands. District 2 encompasses two college towns, Boulder and Fort Collins, with higher populations than the surrounding area and are Democratically partisan. District 7 occupies the space between Denver and Boulder, ensuring another Democratic stronghold. The safe Republican districts are as follows. Districts 3, 4, and 5 encompass the bulk of Colorado’s rural area and, with the exception of District 3 which includes more Democratic-leaning areas like Aspen and other ski towns, are heavily Republican.
More significantly, each of these three rural districts is situated so as not to come into contact with the population and Democratic center of the state, Denver, practically guaranteeing Republican dominance by not diluting that preference. These six safe partisan districts, three primarily urban areas and three rural, leave only District 6 with a combination of rural and urban influences. As such, only District 6 has been competitive since the current map’s implementation and only District 6 has changed political hands.

Figure 12

*2018 Congressional Election Results*

*Note.* Only District 6 has delivered competitive elections within a 10% margin since implementing this district map and only District 6 has ever changed party control.
Limitations

This research is limited by a focus on the 2018 election cycle. That single election is not necessarily representative of larger trends. In fact, 2018 saw a significant increase in Democratic votes which exceeded Republican votes for the first time since 2008. Longer voting trends will need to be analyzed prior to making decisions about how to structure competitive districts. This research also focused on precincts rather than census blocks in creating districts. This practice aided the evaluation of election results which are reported by precinct but limited the ability to deliver population equality at the level census blocks would enable.

This research was also limited by the creation of just two maps for evaluation. Other possible combinations of counties and/or precincts could produce different results. However, the underlying structure identified by population density, partisan index, and cluster analysis will influence any attempt to create competitive districts in a similar way. While additional map attempts may have produced slightly different results, the overall district pattern necessitated by partisan population density will likely reemerge. In preparation for actual map making, additional maps were explored over the course of this research. The pattern that emerged in every case was influenced by population density focused on Denver.

Finally, communities of interest were not accounted for in this research. This is both a limitation and topic for further exploration. The limitation is that not accounting for communities of interest makes this effort different than the one the redistricting commission will face. Communities of interest will act as an additional constraint much as contiguity, compactness, or minimizing county splits. Further exploration into
communities of interest seems warranted for several reasons. First, it is unclear from this research that communities of interest can be accurately, impartially, and reliably identified and located. Recall from the literature review that a community of interest can encompass almost any characteristic. The list of possibilities is far too large to be useful and there is a very real possibility that the only communities of interest that will be included in the district drawing process will be those represented by vocal advocacy groups. Communities of interest are also, by definition, likely to represent partisan voting blocks which go directly against the goal of creating competitive districts. Given their frequent mention in redistricting court cases, it is likely that some allowance will have to be made for communities of interest, but it is far from clear what real benefit they bring to the districting process other than representing their own perceived needs. As a thought experiment, imagine that urban Democrats or rural Republicans perceive themselves as a community of interest due to shared culture, economic activity, religious persuasion, and other cultural characteristics that unite them. Should they be grouped together as a community of interest? Given that communities of interest share the kind of characteristics which will likely make them a partisan voting community, why should they get preferential treatment that ordinary party partisans do not? As a geographer, the concept of communities of interest is appealing. For the practical purpose of drawing district boundaries, they seem far less useful a category.

Conclusion

Given what is known about Colorado’s demographic and partisan starting condition along with the tradeoffs required to create competitive districts, how should the redistricting commission proceed? An important, possibly decisive, first step will be for
the commission members to commit to drawing competitive districts to the best of their ability. Since making competitive districts is listed last among the state’s redistricting criteria and is to be accomplished “to the extent possible” after meeting other criteria, the commission could deem it too difficult or too low a priority to give a concerted effort (Senate Concurrent Resolution 18-004, § 44.3). This research suggests that would be a mistake because competitive districts are possible as long as the tradeoffs required to make them are known and accounted for from the outset. Without a good faith commitment to creating competitive districts, that goal can easily fall to the wayside as the difficulty of complying with other conflicting principles presents a daunting task.

This research measured the impact competitive districts will likely have on compactness and county splits, other criteria that are to be met as able, and found that improvements can be made in all three. Knowledge of the demographic and partisan voting patterns at the start of the process is key to success along with the tradeoffs required.

The commission’s next decision will likely be related to those tradeoffs. Just how many split counties is tolerable? What increase in competitiveness and/or compactness is justified by what increase in split counties? Answers to these questions are beyond the scope of this research and will have to be addressed by the commission, but a good starting point may be to acknowledge that the existing district plan can be improved upon in terms of compactness, competitiveness, and county splits. By recognizing the existing demographic and partisan voting patterns and choosing to adopt a plan that will take them into account, the commission can immediately improve upon the existing plan. The first build attempt that returned the smallest improvement in compactness and competitiveness still increased the number of competitive districts from one to four while reducing the
overall number of county splits. As noted in the limitations, this could have been due in part to the lack of attention to communities of interest, but it illustrates nonetheless that improvements in competition are possible and perhaps at a relatively small price.

It could be that the tradeoffs necessary to attain six competitive and seven compact districts, as was done in the second build attempt, are a bridge too far. Given the Colorado Supreme Court’s past rejection of plans that were “not sufficiently attentive to county boundaries,” it seems likely that the most compact and competitive plan would be unacceptable to the Court due to excessive county splits (*In re Reapportionment*, 2011). The most likely course of action for the commission would follow the minimal county splits attempt. In this case, early decisions concerning the Denver area and highly populated adjacent counties will be crucial to attaining an outcome like the one reached here. A specific decision to focus county splits in the highly populated Denver area will make fewer splits necessary elsewhere.

The excess Democratic vote count in 2018 was an anomaly. The normal pattern has been more Republican than Democratic votes in congressional elections. This means that this research’s approach to offset the excess Democratic votes may be unnecessary following the 2020 census count. What will not change, however, is the high population density surrounding Denver. This makes the problem of creating competitive districts even more difficult because clumping parts of the Denver area together to offset a Democratic vote advantage, as this research did, will only make fewer Democratic votes available to offset what is likely to be even more Republican votes. What is clear from this research is that any attempt to create competitive districts will result in district shapes
that reach back toward the urban core for Democratic voters to offset rural Republican votes.

What is not clear from this research is how desirable a fully competitive districting scheme would be, if it could even be created given other constraints. There may be some truth to the notion that competitive districts will result in candidates that can appeal to concerns from both sides of the political spectrum. It may also be true that this need for common ground could result in more bipartisanship within Congress. What is not clear is how competitive districts might bring rural and urban voters closer to that common ground. It seems just as likely that partisan voters, faced with a much more difficult electoral challenge to get their preferred candidate elected, might resent that fact and engage in even more partisan behavior. What can be said for creating competitive districts is that the perception of fair elections will be enhanced. It is difficult to see much underlying fairness under the current districting scheme where the average win margin is 25% in a state with a nearly equal number of Republicans and Democrats. It is true that the unintentional gerrymander of demographics is at work in this issue, but six safe seats out of seven for the life of the existing plan does not suggest an intentionally fair plan. It could be the case that Brunell (2006) is correct that voters would be happier under a noncompetitive plan where their specific biases would be faithfully represented. It could also be true that the state and nation could benefit from the most partisan voters not getting their way on every point. It is beyond the scope of this research to predict what impact competitive districts may have on the inner workings of government or the welfare of the state or nation. It seems logical, however, to conclude that faith in the
democratic process and the importance of civic duty could be enhanced by the perception of fair elections that competitive districts would bolster.
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