

Segregation and Integration in Dallas County:

**What Do Demographic Differences Between Neighborhoods tell us About the Political
Preference of those Neighborhoods?**

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Abstract

How does environment affect how people decide to vote? If a person lives in a more diverse environment, does that change their fundamental political preference? This research uses both racial demographic information of voters in Dallas County and aggregate election results to draw a conclusion about the voting preference of individuals living within the county depending on the makeup of their precinct. Using 2010 census data to identify the demographic composition of every precinct in Dallas County, this research finds that the white population in the county is heavily concentrated in the north-central region, the black population in the south-central region, and the Hispanic population in the west-central region. Using Texas' 2010 Gubernatorial Election results to identify the electoral outcome of every precinct in Dallas County, this research finds that the north-central region leans Republican, the south-central region leans heavily Democratic, and the west-central region leans slightly Democratic. Through measuring neighborhood level segregation and integration and comparing varying levels of demographic makeup in precincts with voting outcome, this research identifies the relationship between voting preference and the white, black and Hispanic populations. By investigating patterns of segregation in Dallas at both the precinct and county levels, this research finds that segregation polarizes voting preference. This research concludes that in Dallas, a small black population may polarize Hispanic voters to lean heavily Democratic in the absence of a white population.

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1. Introduction

Dallas, Texas is highly segregated by race and ethnicity. The white, black, and Hispanic populations are neatly and dramatically divided across Interstate-30. North of I-30, one finds predominantly white residents; west of I-30, Hispanic residents are the majority; south of I-30, black residents in Dallas make up the highest fraction of the population. Economic opportunity mirrors the racial divide in the city. The highest median household incomes are all concentrated in the whiter northern region, while the blacker southern region consists of neighborhoods with the lowest median household incomes. Racial segregation correlates with the political preference of communities throughout the county and decades of discriminatory policy and purposeful marginalization in Dallas, like much of the rest of the country, has created one of the most segregated and politically polarized cities in the United States [1]. Using racial demographic data in Dallas County, the political preference of neighborhoods throughout the County can be plotted and accurately measured. This divide separating populations in Dallas by race exposes a possibility of predicting the County's political preference along the lines of this demographic separation.

The predictive voting distribution of neighborhoods with racial demographic data involves both the overall racial makeup of homogenous neighborhoods and levels of segregation within given neighborhoods. In this research we focus on the two predominant races and the one predominant ethnicity within Dallas: black, white, and Hispanic. We find that a higher proportion of white or black voters in a given neighborhood leads to higher proportional votes cast for either Republican candidates or Democratic candidates, respectively: When a neighborhood is majority white, there are more votes cast for the Republican candidate; when a neighborhood is majority black there are more votes cast for the Democratic candidate. When a

neighborhood has a high Hispanic population, it may either be Republican leaning or Democratic leaning depending on whether the neighborhood contains either white people or black people, respectively. When an area has a higher Hispanic/black population, the area is more likely to lean Democratic. When an area has nearly no white residents, the Hispanic population tends to vote strongly Democratic. When an area has a higher Hispanic/white population, the area is more likely to lean Republican. This correlation between demographic pairings and electoral preference can be attributed to changes in demographic distributions of the neighborhood the pairings live in.

To understand voting preference in a more granular level, we look specifically at Dallas County. Of the 14 Voting Tabulation Districts in the County with an exceedingly large Hispanic voting age population, the mean fraction of ballots cast for the Democratic candidate was about 73%. Of the 150 VTDs where the Black and Hispanic populations make up the majority, a white voting age population under 10%, the mean fraction of ballots cast for the Democratic candidate was about 89%. In contrast, of the 137 VTDs where white and Hispanic people make up the majority, with the Hispanic and White voting age population making up at least a combined 60% of the total population, the mean fraction of ballots cast for the Democratic candidate was about 53%. This percentage means that for districts in Dallas County with a majority white/Hispanic voting age population, about 53 out of every 100 voters cast their ballot for the Democratic Gubernatorial candidate in 2010. The higher the Hispanic/white population, the higher the chances the neighborhood voted for a Republican candidate. The higher the Hispanic/black population, the higher the chances the neighborhood voted for a Democratic candidate. While many studies examine the correlation between race and voting preference, to the best of our knowledge, little research has been done uncovering trends of voting preference in the

demographic makeup of neighborhoods specifically in Dallas County. This analysis sheds light onto how closely the racial makeup of a geographic area ties with the party that the area is more inclined to vote for.

2. Literature Review

2.1 Vote Dilution and Representation

The U.S. Supreme Court Case *Thornburg v. Gingles* established standards to identify if vote dilution has occurred to a particular group. These factors are known as the ‘Gingles Criteria’ (Thornburg v. Gingles 1986). The Gingles Criteria is made up of three Gingles factors. Gingles One says a racial minority is sufficiently large and compact. This means that a racial group makes up a portion of a community’s population and people who make up the racial group live near each other. Gingles Two says a racial minority votes as a bloc. This means that the racial group consistently votes for the same party. Gingles Three says the majority racial group votes against the minority group’s preferred outcome. This means that the majority racial group consistently votes against the party that the minority racial group votes for. When all three are measured and the second and third factors are satisfied then there is evidence of Racially Polarized Voting (RPV). When voters of different racial groups vote as a block and for opposing candidates, it is known as RPV. As a racial group becomes more homogenous in their party preferences, belonging to the party is predictive of gaining their vote. It can be assumed that as population sorting (segregated, semi-segregated, integrated) in neighborhoods in Dallas County

shifts from white to more majority-minority, voting preferences in these neighborhoods also shifts from less polarized to more polarized voting. Typically, the Gingles Criteria is used in racial gerrymandering court cases to prove that a district map was drawn to dilute the vote of a racial minority. The goal of this research is to use Racially Polarized Voting data with new intent. The intent is to identify if racial segregation is correlative with RPV.

Democratic representation is more than the casting of a vote; it is an act that constitutes the actions of people living within a particular geographic area with regard for the collective good of their fellow citizens [3]. This concept of popular participation in government by the dilution of political power downward to local bodies where citizens can have a form of political self-governance is known as ‘participatory democracy’ [3]. This local level of political participation is where political representation and governance is most powerful. Congressional and Senate Districts are that dilution of political power unto the local level. Existing knowledge related to demographic clustering and representation uses statistical explorations of local politics to reconstruct individual behavior from aggregate data (ecological inference) [4]. Research points to four ways to analyze aggregate election returns and infer individual behavior: the method of bounds, homogeneous areas method, Goodman’s Ecological Regression, and King’s Ecological Inference which combines the method of bounds with simulation procedures [6].

2.2 Majority Minority Communities and the Voting Rights Act

The Voting Rights Act of 1965 (VRA) was implemented to ensure minorities are able to elect their preferred candidate. This act addresses intentional discriminatory election procedures to ensure the legislatures at all levels reflect the diversity of the people they represent. Including its provisions on eliminating poll taxes and literacy tests, the VRA also ensures minorities in

communities with racially polarized voting (RPV) are able to elect their preferred candidate. RPV is when all minorities in a community tend to vote for a particular candidate or policy and the racial majority tends to vote against that candidate or policy.

Section 2 of the VRA applies nationwide to any voting standard, practice, or procedure that results in the denial or abridgment of the right of any citizen to vote on account of race, color, or membership in a language minority group [7]. In a 1980 Supreme Court case, black residents of the city of Mobile, Alabama challenged the constitutionality of the city's at large electoral process. Since the entire city voted for its 3 city commissioners, the white majority controlled every election. Black residents' complaint was that because the majority white residents of the city controlled every election, their large number functionally disenfranchised the African American population's consistently opposing political preference. The Supreme Court ruled for the city however, finding that the plaintiff had to prove discriminatory intent in the standard, practice, or procedure's enactment to fit under the protections of Section 2 [9]. As a result, Section 2 of the Voting Rights Act was amended, changing prohibitions against 'discriminatory intent' to 'discriminatory effect', allowing the Voting Rights Act to be more responsive to cases like this one [5].

Section 5 was designed to ensure that election practices or procedures in *covered jurisdictions* were not created with discriminatory intent, and these jurisdictions are subject to Attorney General and District Court oversight. After administrative review by the courts on the election practices of covered jurisdictions, changes in the voting methods of covered jurisdictions cannot be implemented until a clear determination on the intent has been obtained [7]. Covered jurisdiction is identified in Section 4 and is determined to be if less than 50 percent

of persons within the voting age are registered to vote in November 1, 1964, or that less than 50 percent of persons within the voting age did not vote in the November 1964 presidential election.

2.3 Statistical Analysis

The method of bounds in ecological inference is the first leg in a possible four-legged approach to analyze aggregate data. The method of bounds model in ecological inference uses election data with population information to draw a correlation between voter makeup and demographic populations and can be used to derive Goodman’s Ecological Regression and King’s Ecological Inference. The method provides a percentage bound for the votes a racial group casted for a particular party in a given political boundary. If census data indicates that a county in a district is 60 percent white and 40 percent black and election results indicate that the two-party vote is divided 55:45 in favor of the Republican, one can use the equation $U_1 = (A_{11} * C_1) + (A_{21} * C_2)$ to draw a contingency table that relates the percentage of one party to the percentage of a race for the method of bounds [6]. Percentage of Republicans is represented by U_1 , percentage of whites who voted Republican is represented by A_{11} , the percentage of the white population who came out to vote (for purposes of this example we are assuming every voting age white person turned out to vote) is represented by C_1 . A_{21} represents the percentage of the black population who voted republican. C_2 represents the percentage of the black population who came out to vote (for purposes of this example we are assuming every voting age white person turned out to vote).

Table 1 Hypothetical Relationship between Party and Race in Texas, 1999				
		Republican	Democrat	
White	A_{11}	A_{12}	$C_1 =$.60	
Black	A_{21}	A_{22}	$C_2 =$.40	

A_{11} = proportion of whites who voted Republican, A_{12} = proportion of whites who voted Democrat, A_{21} = proportion of blacks who voted Republican, A_{22} = proportion of blacks who voted Democrat. The combinations of proportions by race add up to 100 because there was 100% voter turnout for each race. So, $A_{11} + A_{12} = 1.0$ and $A_{21} + A_{22} = 1.0$. To find the bounds it is necessary to create hypothetical constraints in identifying the maximum number of Republican voters for each race and the minimum number [6]. Assuming all Republicans are white, the maximum number of white Republican votes can be measured by setting $A_{21} = 0$. Substitute the remaining numbers to compute the maximum

$$[.55 = (A_{11} * .60) + (0 * .40)]$$

$$[A_{11} = \frac{.55}{.60}]$$

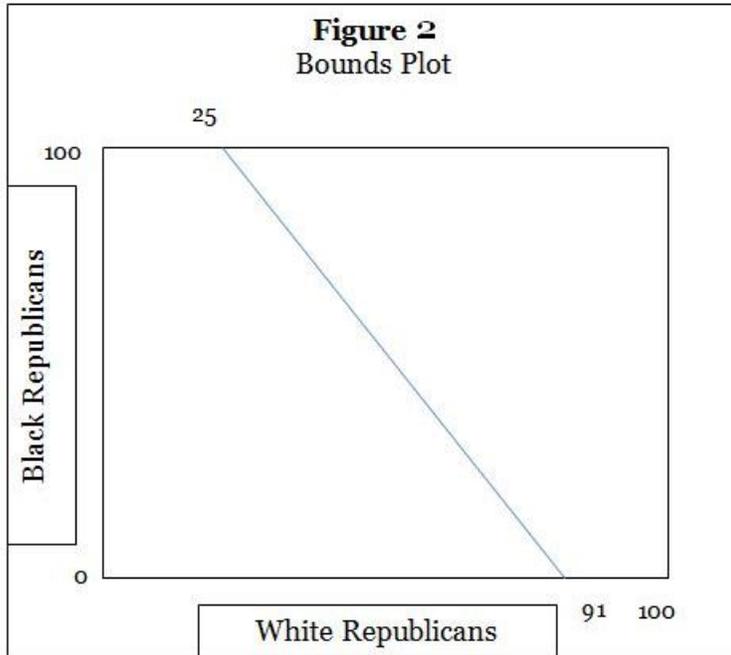
$$[A_{11} = .9166]$$

Assuming all of the black voters voted Republican, the minimum number of white republican votes can be measured by setting A_{21} equal to 1.0.

$$[.55 = (A_{11} * .60) + (1 * .4)]$$

$$[.55 = .6A_{11} + .4]$$

$$[A_{11} = .25]$$



The bounds plot shows the maximum and minimum percentage of whites who voted Republican. Changing the proportion of blacks who voted Republican changes the bounds for the white Republican percentage and serves to overcome the bounds problem where the bounds are too wide to be useful [14].

The homogeneous areas method assumes everyone in an area is of the same race. In the Texas case, supposing everyone in Texas' 1999 district 10 lived in counties that were of homogeneous races, two hypothetical counties of all black and all white can be represented. In the all-black county 20 percent could have voted Republican while 80 percent voted Democrat. This would mean the vote went 20:80 Democratic. In the all-white county 40 percent could have voted Democratic while 60 percent voted Republican. This would mean the vote went 60:40 Republican. Unlike a method of bounds plot the bounds in these counties can be represented by a single point on an axis [6]. Leo Goodman's Ecological Regression (ER) method attempts to

solve the wide range produced by the method of bounds and the unrepresentativeness by the homogeneous areas method [13].

ER does not make any particular assumptions that the racial groups voted the exact same way and it does not take any bounds into consideration. ER uses data from all the counties to produce population voting estimates [6]. With the equation $A_1 = A_{11} + (A_{21} - A_{11})C_2$ the least squares regression line for racial polarization in the county can be drawn. King's ecological inference takes advantage of computing power to incorporate variation between counties [11]. Quantitative geography weights spatial structure in King's Ecological Inference to come out with less biased estimates for ecological data [4]. In this research, we use linear regression to provide a population estimate for voting preference in the county assuming 100% voter turnout and the fraction of turnout is the same in every precinct in the county. Our use of linear regression is a simplified analysis of Goodman's Ecological Inference, but still used in practice. [15]

2.4 Conclusion and Significance

This thesis is interested in using census data to identify and analyze levels of segregation in the potential voting preferences of populations in Dallas. To our knowledge, little research has been conducted in finding a correlation between levels of segregation, and levels of racially polarized voting. With the relationship between population sorting and voting preference identified in Dallas County, it could also then be possible to predict voting trends in the counties across the state and with hypothetical changes to Texas' population depending on migration. We hypothesize that Dallas County's voting preference can be reasonably predicted at the neighborhood level using demographic information of race and ethnicity of 2 or more demographic groups. We use measurements of Dallas County's demographic populations and

voting patterns to identify correlation between the demographic makeup of precincts across Dallas County and the level of polarized voting preferences that exists within those precincts. This thesis provides a step in bridging the gap between quantitative analysis of aggregate data and political analysis of voting preference.

3. Methodology

3.1 Overview

To investigate the relationship between population sorting within precincts and voting preference, we use aggregate data and linear regression to measure the levels of preference demographic groups have for a Democratic or Republican candidate. Precincts that are more segregated will likely lean one way in voting preference. This thesis takes a quantitative research approach that draws on the use of empirical data analysis to measure racial segregation in precincts which would then be used to identify the level of polarized voting that exists within those precincts. We infer the population preference of racial and ethnic demographic groups from aggregate data to assume individual level voting behavior. To infer the voting behavior of racial and ethnic groups in different levels of precinct population sorting (segregated, semi-segregated, integrated), census data, demographic data, and election data will be used to derive figures on demographic makeup and voting pattern. This thesis will also use analysis of segregated, semi-segregated, and integrated neighborhoods in Dallas County to draw conclusions about the voting preference of communities. The implication of finding a relationship between population sorting within neighborhoods and voting preference would mean that the more

homogenous a precinct is the more predictive of the precinct's political preference. With assumptions on voting preference derived from varying levels of homogeneity in neighborhoods throughout the county, we can draw some conclusion on voting preference in integrated regions.

For every census tract and precinct in Dallas County, we have created an assignment for the White Voting Age Population, Black Voting Age Population, Hispanic Voting Age Population, Black + Hispanic Voting Age Population, White + Hispanic Voting Age Population, and White + Black Voting Age Population. For each census tract we have created is a color ramp of what fraction of the VAP is Black + Hispanic vs. White. As an example, we code a higher percentage of Black + Hispanic people in a census tract within a precinct as colored black while a higher percentage of White people in a census tract within a precinct as colored white. As a result, there are some grey regions, some predominantly white colored regions, and some predominantly black colored regions. The varying colors indicate varying racial demographic percentage. In locations where there seems to be integration (grey) we can zoom into the census tracts and see if there is identifiable segregation in a finer level or the people living in the area seems to be integrated. For each region, to determine how much of each race votes together or apart, we build code using python to extract census data to identify the racial make-up of each precinct. We then employ linear interpolation to determine different demographic voting preferences in Texas' Gubernatorial election in 2010.

3.2 Data Compilation Extraction

Extracting statewide shapefiles

```
In [3]: if not os.path.exists(paths.getSF("geoIDCensusBlocks")):
#pruning original cblock data
cblockSF = gpd.read_file(paths.getSF("tl_2018_48_tabblock10"))
cblockPrunedSF = cblocksF[["GEOID10", "geometry"]]
cblockPrunedSF = gpd.GeoDataFrame(cblockPrunedSF, crs={'init' : 'epsg:3081'}, geometry=cblockSF.geometry)
cblockPrunedSF.to_file(paths.getSF("geoIDCensusBlocks"))
else:
#reading pruned shapefile
cblockPrunedSF = gpd.read_file(paths.getSF("geoIDCensusBlocks"))

In [4]: precinctSF = gpd.read_file(paths.getSF("Precincts"))
precinctSF = gpd.GeoDataFrame(precinctSF, crs={'init' : 'epsg:3081'}, geometry=precinctSF.geometry)
precinctSF = precinctSF.to_crs({'init': "epsg:4269"})
```

Figure 2. Code used to extract statewide shapefiles.

We retrieved three levels of data. The first is population data. The second is voting data. The third is county, precinct, and census tract shapefiles. The population data is county level demographic data and census tract level demographic data. The voting data is precinct level general election results from Texas' 2010 Gubernatorial Election and precinct level voter registration and turnout data during the same time period. The shapefiles retrieved are of the State's precincts and voter tabulation blocks. We use python programming through Jupyter Notebook to extract the statewide shapefiles and county level shapefiles. We are also load the precinct and census tract shapefiles in QGIS, extracting demographic and voting information in census tract and precincts on only the regions we focus on.

Extracting county level shapefiles

```
In [5]: cnty = 113
cbCntySF = cblockPrunedSF[cblockPrunedSF.GEOID10.str.startswith("48" + str(cnty))]
pctCntySF = precinctSF[precinctSF.CNTY==cnty]

In [25]: singlePctSF = pctCntySF[pctCntySF.PCTKEY=="1133008"]
singlePctGeom = list(singlePctSF['geometry'])[0]
cbPctSF = sfm.extractIntersectingFeatures(singlePctGeom, cbCntySF)

In [26]: # checking geometries
import matplotlib
import matplotlib.pyplot as plt

transparentColorMap = matplotlib.colors.ListedColormap([(0,0,0)])

base = cbPctSF.plot(edgecolor=(0,0,0,1))
singlePctSF.plot(ax = base, cmap=transparentColorMap, linewidth=3, edgecolor=(0,0,0,1))
```

Figure 3. Visualizing Racial Demographic Makeup of Precincts Using Color Ramp

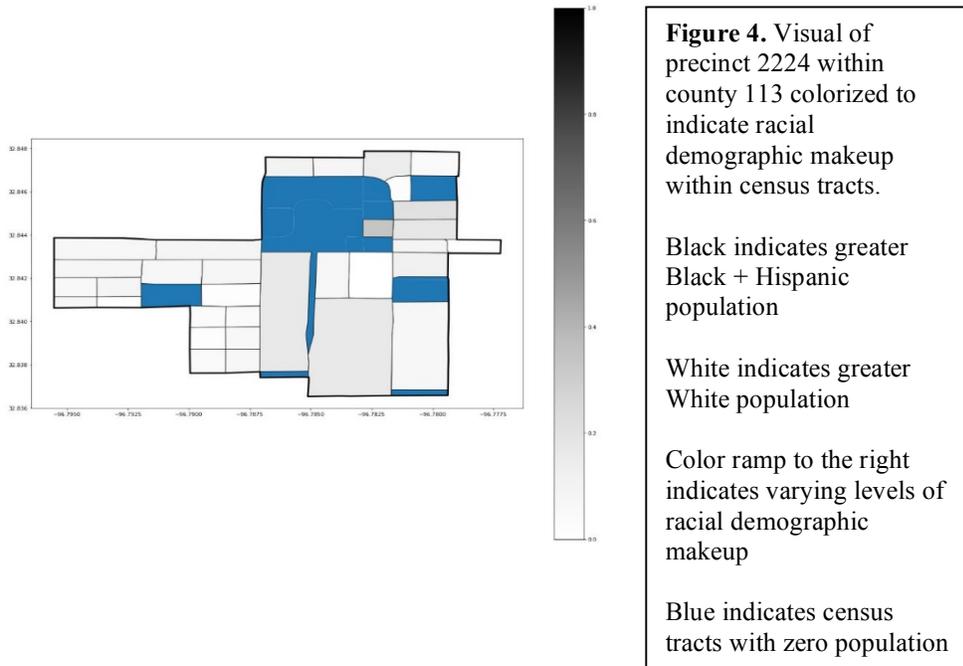


Figure 5. Black/Hispanic vs. White Census Tracts in Dallas County

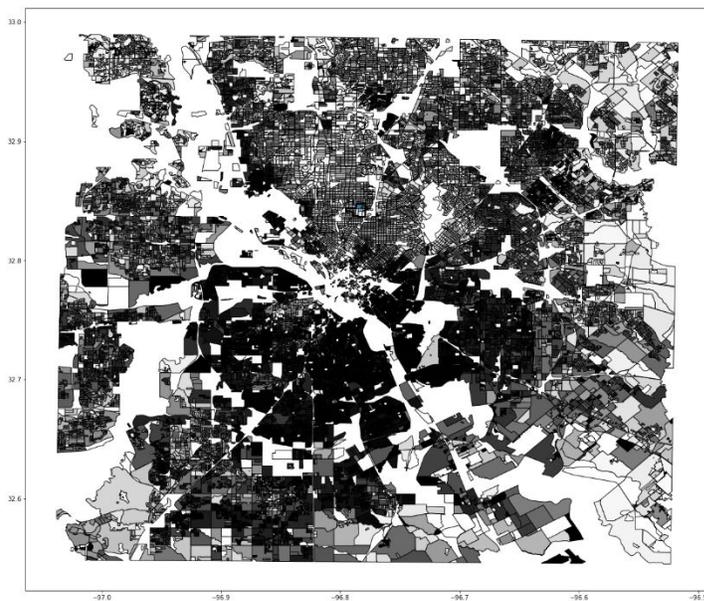


Figure 5 is a visual of county 113 in Texas: Dallas County. Varying levels of racial demographic makeup within census tracts are indicated by varying levels of color within those census tracts. Population percentage is calculated by the racial demographic we are looking for divided by the total population of people living within each census tract. Black indicates greater black + Hispanic population, White indicates greater white population and varying levels of grey indicate varying levels of integration. This map depicts Dallas County and indicates that there is a greater percentage of black + Hispanic people at the lower center of the city. Census tracts directly below Trinity River is heavily Black + Hispanic. There are pockets of predominantly white census tracts throughout the county but there seems to be a large amount of Black + Hispanic populations in the lower-center region of the county than the upper-center region. We investigate further in the following sections.

Figure 6. Black Population to White population Census Tracts

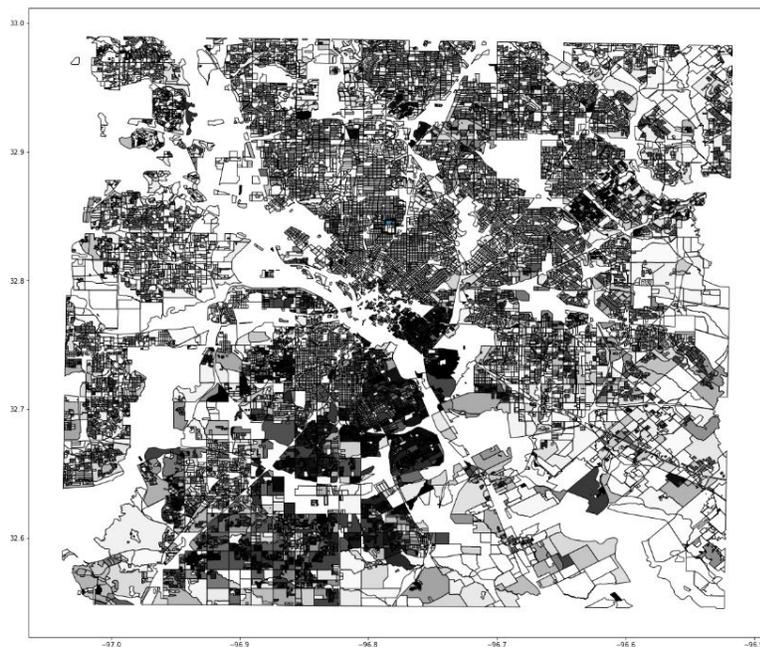


Figure 6 compares only Black and White populations within the County. Varying levels of racial demographic populations within precincts is depicted by varying levels of color. In this map the center of Dallas County seems to have a large black population. After quantifying the levels of segregation within precincts, we can then compare the voting preferences between precincts.

4. Racial Segregation

4.1 Segregation Within Dallas County

To understand racial segregation in Dallas, we begin by visualizing the concentrations and the geographic distribution of the two major racial groups and one ethnic group in Dallas County: Black, White, and Hispanic identifying. In this analysis, we first examine how Dallas' racial groups are distributed by separately identifying the population percentage of the black, white, and Hispanic populations in each precinct (see Figures 1,3 and 5). Through mapping Dallas' population concentrations by race, it is evident that there is a high concentration of Black people living in Dallas' south side (Figures 1 and 2), White people living in Dallas' north side (Figures 3 and 4), and Hispanic identifying people living in Dallas west side (Figure 5 and 6). It is striking how concentrated white people are in the north-central Dallas, black people are in south-central Dallas, and Hispanic people are in west Dallas.

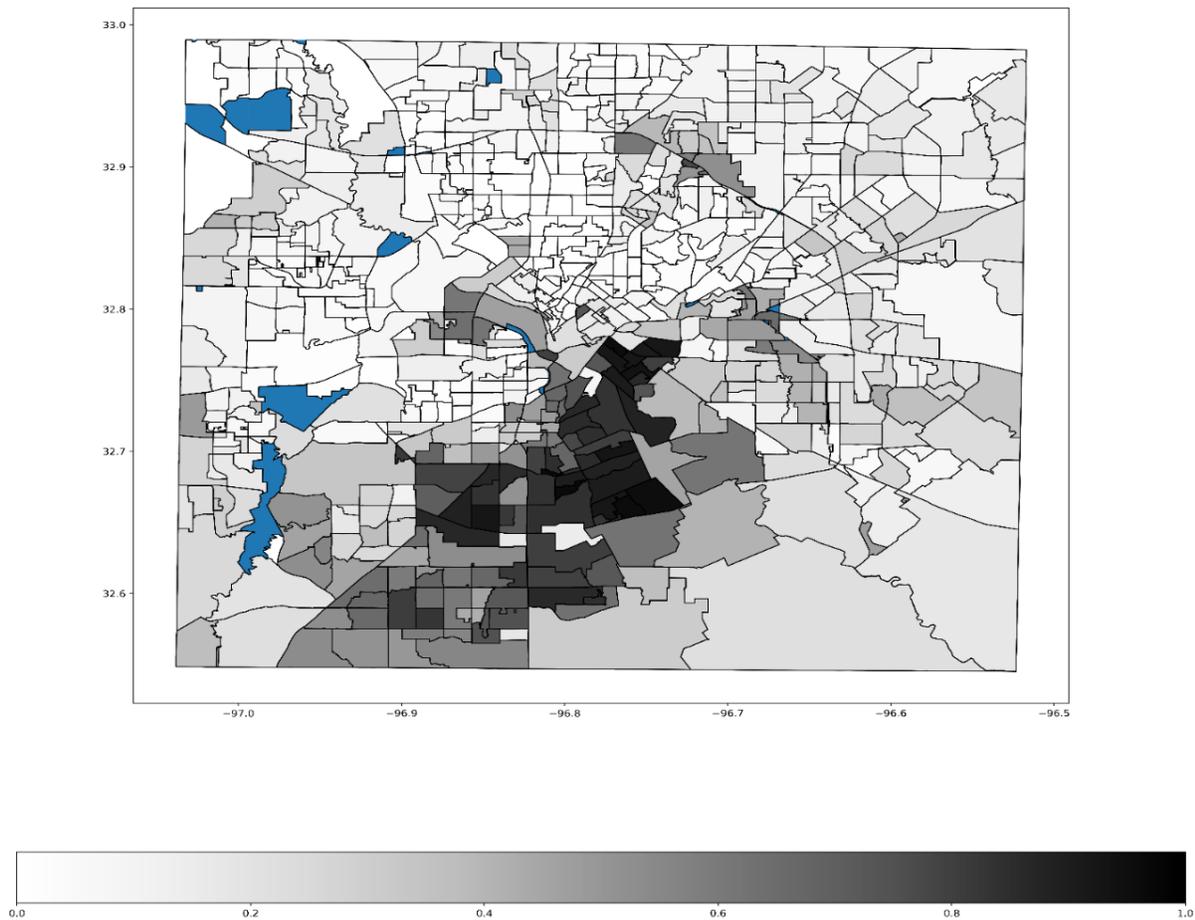
In north-central Dallas, right above Interstate-30 which runs through central Dallas from East to West, resides nearly 20% of the County's white population while just a few miles away in south-central Dallas, right below Interstate-30, resides nearly 20% of the County's black population. In north-central Dallas there are so few black people that in several precincts their

populations can be counted in one hand. However, just traveling a few miles south, black people make up over 80% of the total population in many precincts. This drastic racial separation between Dallas' north and south side reveals a strong degree of racial segregation in the County. In the current section, we dive deeper into the matter of racial segregation by looking at racial and ethnic population concentrations between and within precincts. We identify possible signs of segregation and integration within precincts by looking at population concentrations in census blocks.

In examining Dallas' black population, we visualize their concentration by categorizing each precinct by percentage of black people and visualizing this categorization through a map. Figure 1 displays the concentration of Dallas' black population. This map of Dallas County's black residents shows their population's concentration at the precinct level. The darker the precinct the higher the population of black people. The lighter the precinct the lower population of black people. The legend to at the bottom indicates a concentration going from 0 to 1—0 being the lightest and 1 being the darkest. Blue indicates no recorded population. We find that there is a considerably high population of black people in south-central Dallas and a considerably low population of black people in north-central Dallas.

If a precinct has a single racial group that makes up at least 80% of the total population that precinct can be said to have a high concentration of a single race, therefore it is segregated at the precinct level. Figure 2 is a map of every precinct in Dallas County with a black population at or over 80% of the total precinct population. The precincts with this black population are colored yellow. The precincts without this concentration are colored light blue. Every precinct identified with a black population over 80% is below Interstate-30 which runs through central Dallas from East to West.

FIGURE 1. *Population Concentration of Black People in Dallas, 2010*

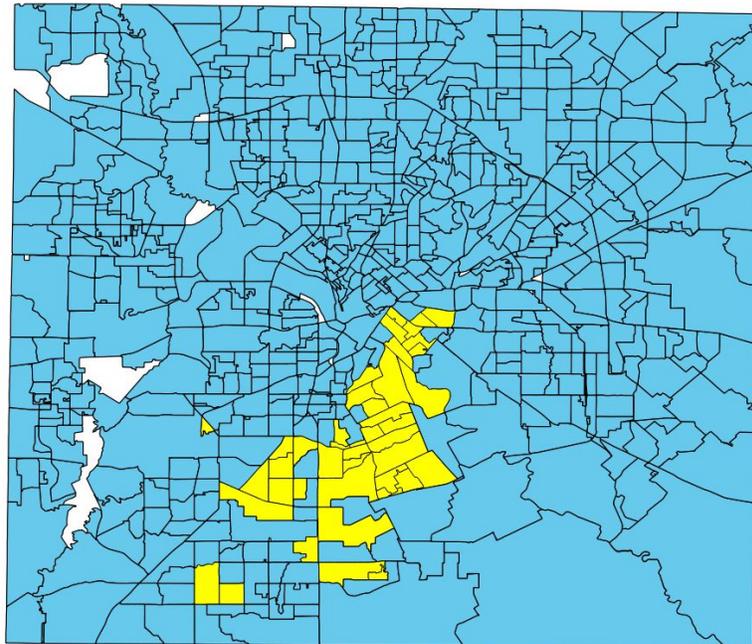


Source: Visual by Author (2019)

It is evident through Figure 2 that since every precinct with a black population over 80% is in South Dallas, there is an incredibly high concentration of black people in Dallas' south side. In fact, we find that in this region of Dallas there are about 103,000 black people out of a population of about 120,000 and a total county black population of about 500,000. This population concentration means about 20% of the county's total black population lives in just a

few precincts right below the county's interstate. Conversely, we find almost no black people just above the Interstate. In this set of precincts identified in Figure 4, we find that there are about 4,000 black people out of a total population of about 180,000 which is just around 2% of the area's population and less than 1% of the county's total black population. This hyper-concentration of black people in south-central Dallas and under-concentration in north-central Dallas, points to a high degree of racial segregation in the county.

FIGURE 2. *Yellow Precincts have over 80% Black Population, 2010*



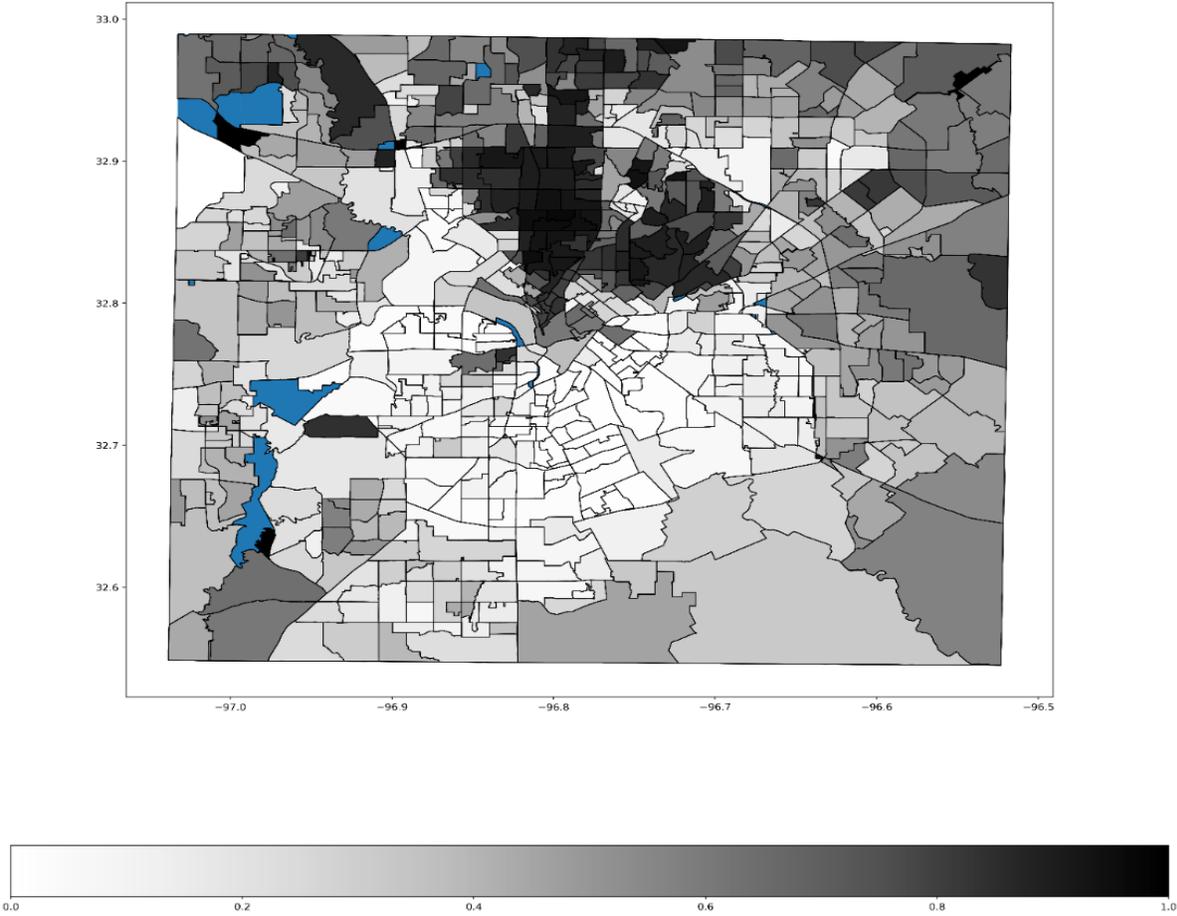
Source: Visual by Author (2019)

If Dallas was only comprised primarily of white and black people, Figure 1 would be sufficient to show where white people live. Because, however, there is also a large Hispanic

population, we continue our investigation by examining where Dallas' white population lives at the precinct level (see Figure 3). The darker precincts indicate a higher white concentration while the lighter precincts indicate a lower white concentration. The legend to the right indicates a concentration going from 0 to 1—0 being the lightest and 1 being the darkest. Blue indicates no recorded population. We find that North-central Dallas has an incredibly high concentration of white people while there is a much lower concentration of white people in South Dallas. North-central Dallas has a considerably low population of black people and a considerably high population of white people which stands in contrast to Dallas' south-central side. In fact, there are adjacent precincts across I-30 that have around 90% white population to the North, and around 90% black population to the south.

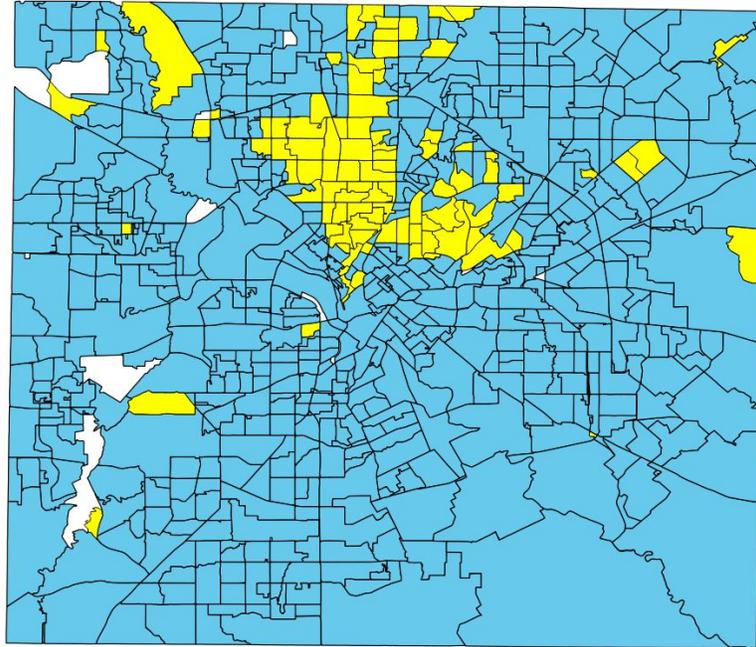
The precincts in north-central Dallas have a white population considerably over 80% and a black population that is so low it would be hard to imagine that just across the highway the communities are almost entirely black. Figure 4 is a visual of every precinct in Dallas County with a white population at or over 80% of the total precinct population. The precincts with this white population are colored yellow. The precincts without this concentration are colored light blue. Nearly every precinct identified is above Interstate-30. These precincts in north-central Dallas have a white population of about 160,000 of a total population of about 180,000; county wide, the white population is 780,000. This means that white people make up nearly 90% of the given region in north-central Dallas and about 20% of the county's entire white population. Conversely, just a few miles away in south-central Dallas, there are, in total, roughly 3,800 white people, making up about 3% of the area's total population. This hyper concentration of Dallas' white residents in north-central Dallas and hyper concentration of Dallas' black residents in south-central Dallas shows the extent to which populations are separated in the county.

FIGURE 3. *Population Concentration of White People in Dallas, 2010*



Source: Visual by Author (2019)

FIGURE 4. *Yellow Precincts have over 80% White Population, 2010*

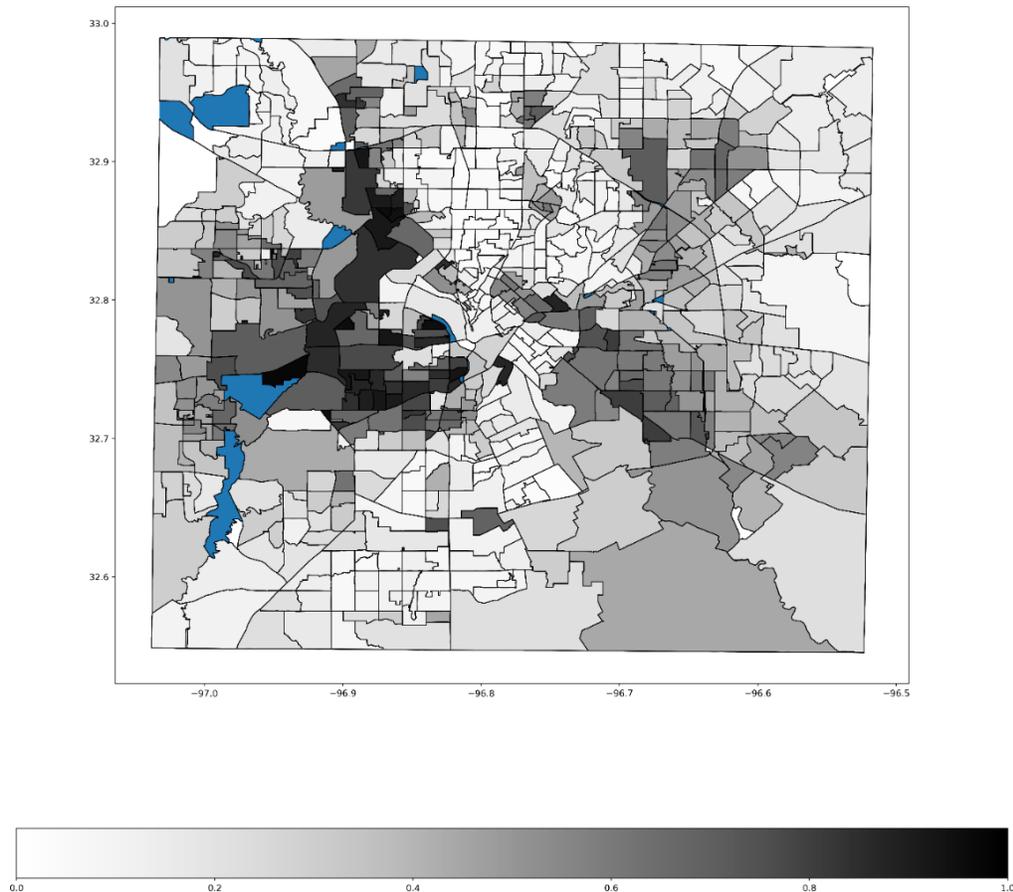


Source: Visual by Author (2019)

In examining segregation, we also identify the concentrations of the Hispanic population. Figure 5 displays the population concentration of Dallas' Hispanic-identifying residents. It depicts the concentration of the Hispanic-identifying population in Dallas County in the precinct level. The darker the precinct the higher the Hispanic-identifying population, the lighter the precinct the lower the Hispanic-identifying population. The legend to the right indicates a concentration going from 0 to 1—0 being the lightest and 1 being the darkest. Blue indicates no recorded population. Dallas has a higher concentration of Hispanic residents in West Dallas but there is also a notable concentration of Hispanic residents in East Dallas.

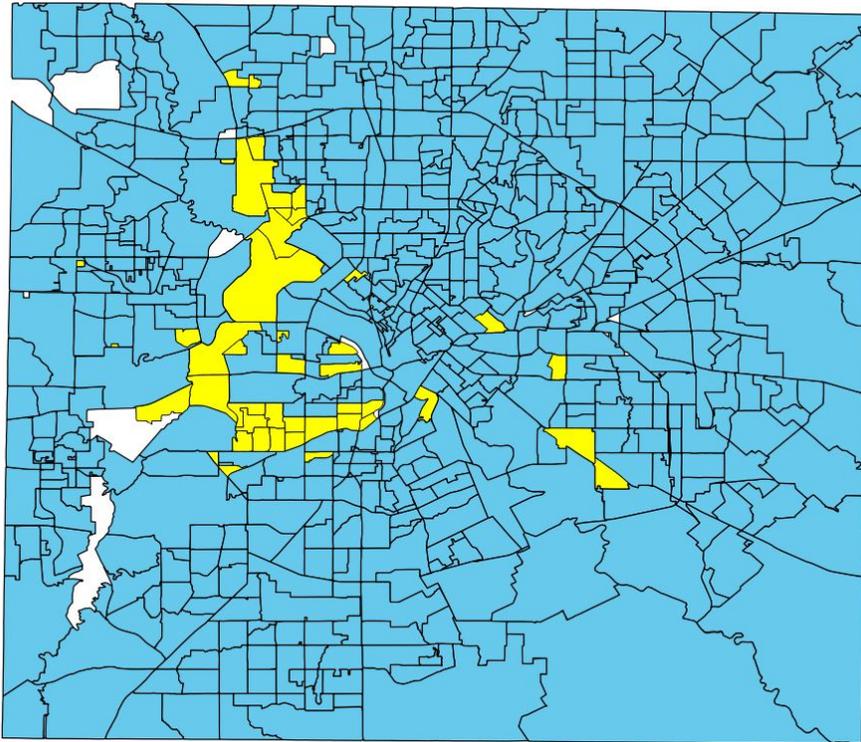
Figure 6 is a map of every precinct in Dallas County with a Hispanic population at or over 80% of the total precinct population. The precincts with this Hispanic population are colored yellow. The precincts without this concentration are colored light blue. Nearly every precinct identified is to the West of the County. There is evidence of racial concentration of Dallas' Hispanic residents. Unlike the hyper-concentration of the County's white residents to the North or the County's black residents to the South, the Hispanic population is concentrated more to the West making a geographic clump like the White and Black populations.

FIGURE 5. *Population Concentration of Hispanic-identifying People in Dallas, 2010*



Source: Visual by Author (2019)

FIGURE 6. *Yellow Precincts have over 80% Hispanic-identifying Population, 2010*



Source: Visual by Author (2019)

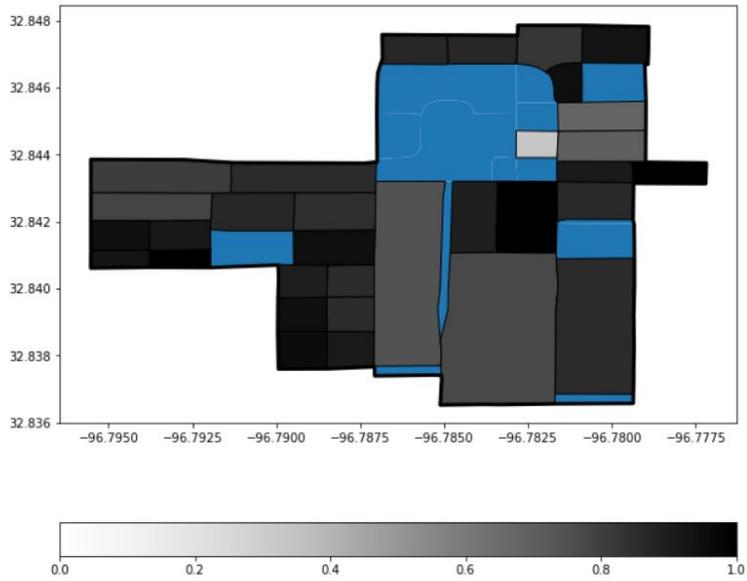
Section 4.2 Neighborhood Level Segregation and Integration

To understand population distributions in a more granular level we examine how racial demographic populations differ between census blocks. Most segregated precincts in north-central Dallas are homogenous within. Figure 7 is a visual of *precinct 1132224* which is an example of a precinct in north-central Dallas containing a large fraction of white residents. A darker hue indicates a higher population of white residents. The color ramp below the visual indicates varying levels of concentration of the white population. Blue indicates the census block has a recorded population of zero. This precinct has 4,694 people. The number of White people

in the precinct is 3,889; the number of black people is 201; the number of people who identified as Hispanic is 326. This precinct is located right in the majority white region of North Dallas and the racial demographic makeup of the precinct is evident of its geographic location, with the white population making up more than 80% of the total population. Of the 33 census blocks with people recorded to be living in the precinct, 32 of them have a white population making up over 70% of their total population. The one census block that is under this 70% still has a white population of nearly 50%. Overall, the demographics of the precinct are fairly uniform across its census blocks. In this precinct, there is such a high fraction of white people and low fraction of black people that it is not easy to identify racial segregation in the census block level. The census block with proportionally the lowest amount of white people is the lightly colored block near the middle on Figure 7 and even that block has a considerably high number of white people indicated by its greyish color. Understanding the clustering of races inside precincts allows us better perspective in analyzing segregation but just like a large number of precincts in Dallas' north-central side, the population of non-white people is so low that this area serves as a good study on deciphering individual preferences of white people from aggregate data from this homogeneous area.

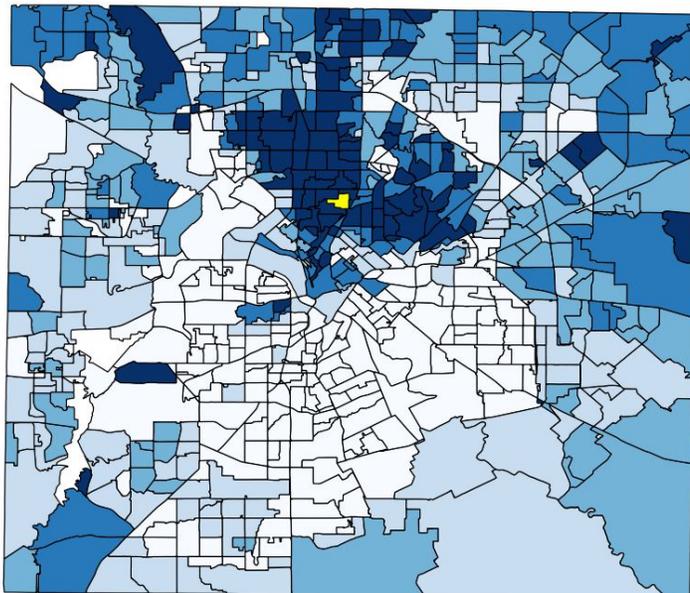
FIGURE 7. Precinct 1132224 in Dallas County Colorized (2010)

Out[22]: <matplotlib.axes._subplots.AxesSubplot at 0x4802c88b70>



Darker color indicates a higher white population fraction. *Source:* Visual by Author

FIGURE 8. Location of Precinct 1132224 in Dallas County, (2010)



Source: Visual by Author

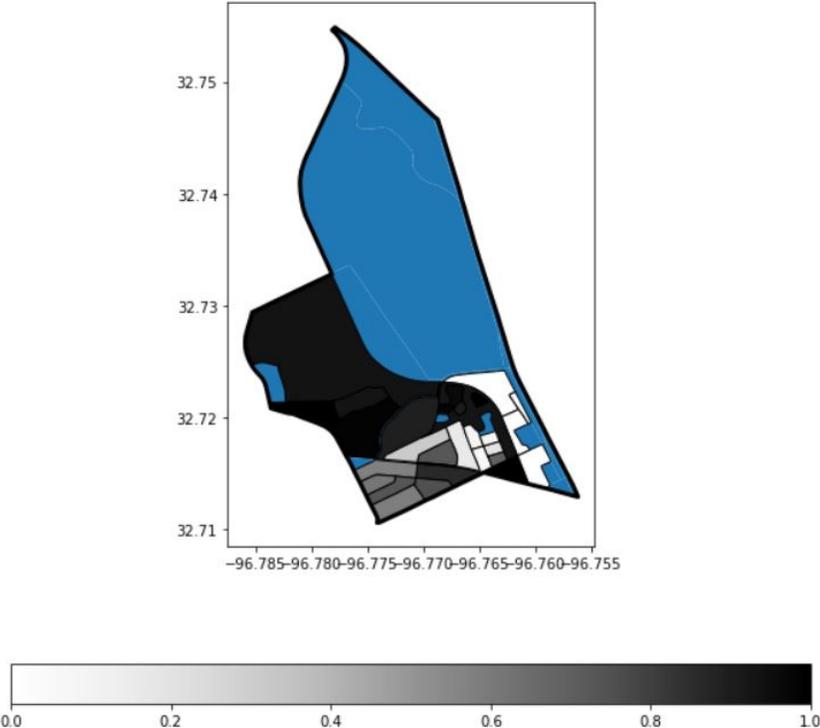
Figure 8 is a visual of precinct 2224 within Dallas County, colorized to indicate the prevalence of the white identifying population within census tracts. A darker hue of blue indicates a higher population of white residents. About 6 precincts below precinct 2224 is downtown Dallas. This is where the geographic separation of the black population and the white population within Dallas County starts to become noticeable.

Unlike Dallas' north-central side that is nearly completely homogeneous allowing for no visual evidence of integration or segregation between census blocks, much of Dallas' hyper-concentrated black precincts still have populations of other races although these populations are visually segregated between precincts by race. Figure 9 is a visual of *Precinct 133040* colorized to indicate the prevalence of the black identifying population within census blocks. Figure 10 is a visual of the same precinct, colorized to indicate the prevalence of the Hispanic-identifying population within census blocks. A darker hue indicates a higher population of either black or Hispanic people. The color ramp below the visual indicates varying levels of concentration of the populations. Blue indicates the census blocks has a recorded population of zero. There are so few white people in this precinct, colorizing their population does not add much to our analysis. There are more black people living in the West side of the precinct while it seems that the Hispanic population lives more in the East side. Compared to precinct 2224, Dallas County's precinct number 3040 has a much higher black population and has evidence of neighborhood level racial segregation between the black and Hispanic populations. The precinct has 3,757 people. The precinct has a black population of 3,073 people, a white population of 45 people and a Hispanic-identifying population of 654 people. It is evident by the hyper-concentration of the black population in the Western side of the precinct that there is micro-level segregation between

the black population and the Hispanic/white populations. From the about 30 census blocks with recorded populations, 20 blocks have a black population over 60% while the rest have a black population not exceeding 50%. This precinct lies in Dallas' majority black side and right by William Blair Jr. Park. The precinct is only a few precincts away from Dallas' majority white side but is home to fewer than 1% white people. To understand levels of segregation within precincts we have so far only used visual insights. Visual differences between census block can only tell us so much about the population distribution in precincts. We use the deviation of a racial group's fraction between census blocks to help us further understand segregation and integration in the County.

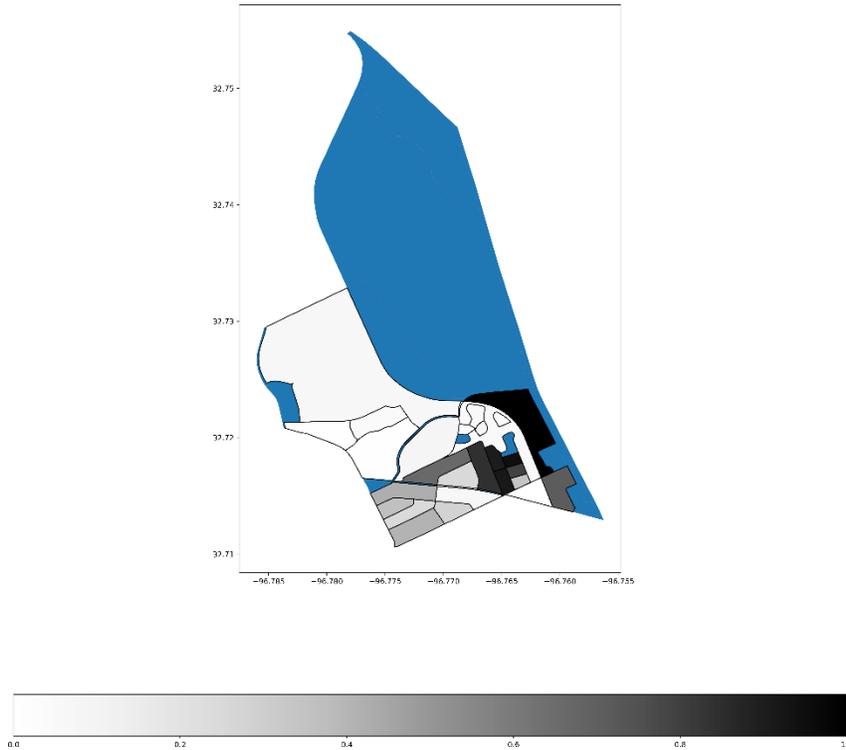
FIGURE 9. White Concentrated *Colorized Map of Dallas' Precinct 1133040, (2010)*

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Out[31]: <matplotlib.axes._subplots.AxesSubplot at 0x4802791c88>
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Darker color indicates a higher white population fraction. *Source:* Visual by Author

Figure 10. Hispanic Concentrated *Colorized Map of Dallas' Precinct 1133040, (2010)*



Darker color indicates a higher Hispanic population fraction. *Source:* Visual by Author

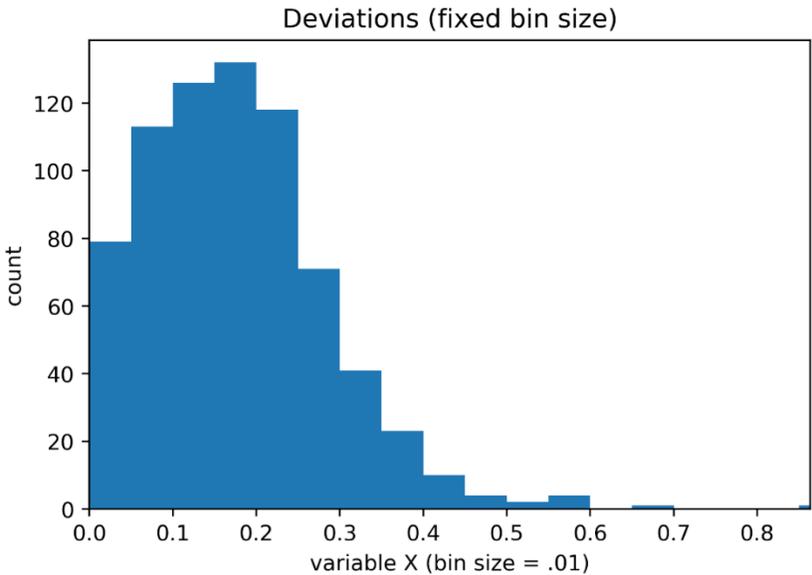
Section 4.3 Measuring Neighborhood Level Segregation and Integration by Deviation

In analyzing residential segregation in Dallas County, we measure how demographic populations in Dallas County are concentrated within census blocks and compare the population concentrations of each census block within a precinct. We do this analysis by identifying how

different each census block's population is. By taking the population fraction of each block we identify variation between blocks by measuring how much the white population deviates between census blocks in a given precinct from the precinct's average.

Here are some qualitative examples in understanding how population deviation plays a role in segregation: Precincts with incredibly high percentages of a single race means those precincts are racially segregated (the entire precinct is composed of pretty much the same race). Precincts with reasonable percentages – i.e. 50% white, 20% black, 30% Hispanic – of different racial groups indicates those precincts are racially integrated (there is a mix of different races in the precinct). To understand how the racial groups are distributed within these segregated and integrated precincts we can then look at the concentration differences between the precinct's averaged demographics and the variations with its census blocks. Analyzing how the census block demographics deviate from the demographics of a whole precinct gives us another level of understanding of the segregation that exists in the area. If the demographics of census blocks within a precinct are significantly different from the demographics of the precinct, then even though the population might seem integrated at the precinct level, the precinct is still segregated, just at a finer level. If the precinct has a low deviation, then their census blocks have similar fractions of races to the precinct they are contained in.

FIGURE 11. Histogram of the Deviation of Precincts in Dallas County, 2010

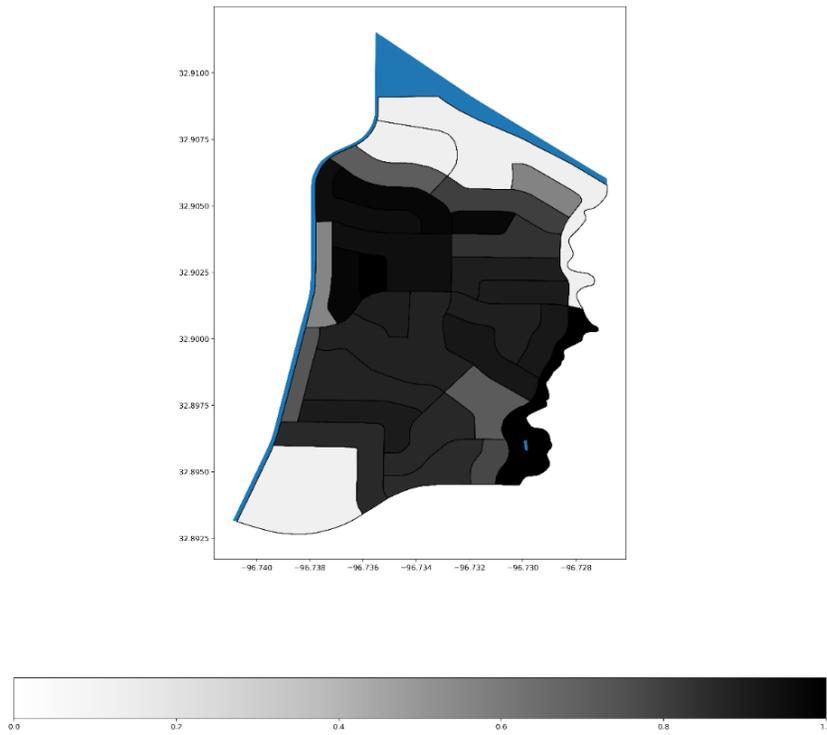


Source: Visual by Author, (2019)

A precinct with a high population of multiple races would be considered integrated. However, if the demographics of the census blocks within the precinct largely deviates from the precinct’s average demographic makeup, then that precinct may be segregated across census blocks. We find deviations for the white population over all of Dallas county’s precincts with a recorded population, which is 725 precincts, and find an average deviation of 17.7%. Precincts that have a lower deviation, below 17.7%, are more integrated within census blocks; precincts above this are more segregated. For example, *Precinct 1131042* in Dallas’ north side has many races but a high deviation in its census blocks, indicating that although the precinct is integrated in the aggregate, it is hyper segregated from within. In the precinct, there are 1,881 white people; 866 Hispanic people; and 620 black people. From a total population of 3,437, white people make up about 60% of the population, Hispanic people make up about 21% of the population and

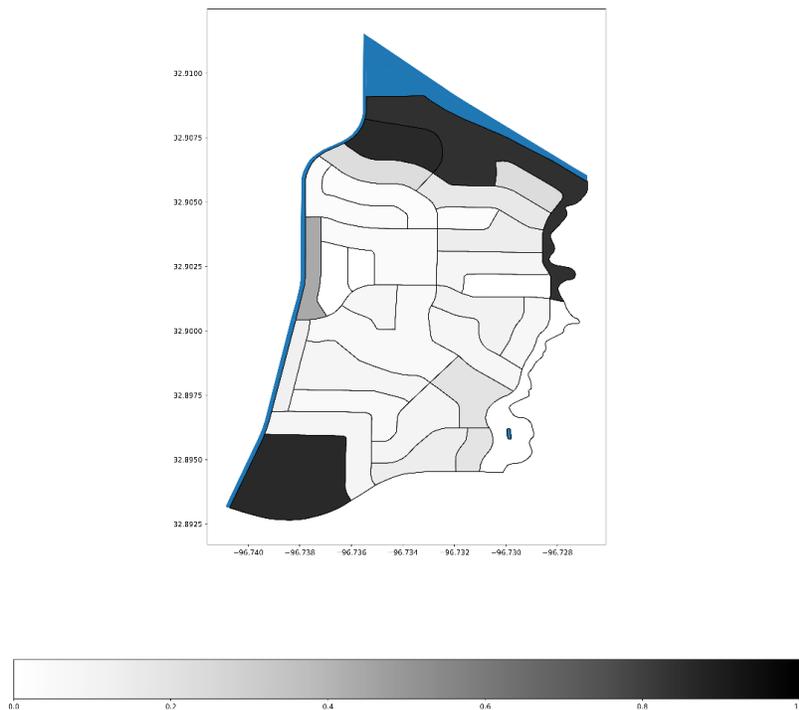
Black people make up about 17% of the population. With these relatively large populations of different races, it is possible to assume that this precinct is integrated. However, with a deviation score at about 34.7%, which is much over the county's mean of 17.7%, it is evident that there is segregation between neighborhood blocks within the precinct. Figure 12 and 13 show the distribution of races in the precinct. Figure 12 shows the blocks that have the most white people while figure 13 shows the blocks that have the most black/Hispanic people. In Figure 12, the darker the census blocks show where there is a higher concentration of white people while the lighter census blocks show the lower concentrations of white people. In contrast, In Figure 13, the darker the census block the higher the fraction of black/Hispanic people. The lighter the census block the lower the fraction of black/Hispanic people. Figure 13 shows that the census blocks with the fewest white people have the most black/Hispanic people while the census blocks with the most white people have the fewest black/Hispanic people. It is evident that there is a considerably low white populations in this precinct's far north and far south sides, while the black and Hispanic populations are heavily concentrated in these areas. The white population in the precinct is not only hyper-concentrated in the center blocks, there is relatively few black/Hispanic people in these blocks compared to how many live in the far north and south side. The blue indicates no population. This precinct is evidence of racial segregation in the neighborhood level in a precinct that seems to be diverse.

FIGURE 12. *Precinct 1131043 White Population Concentration, 2010*



Source: Visual by Author

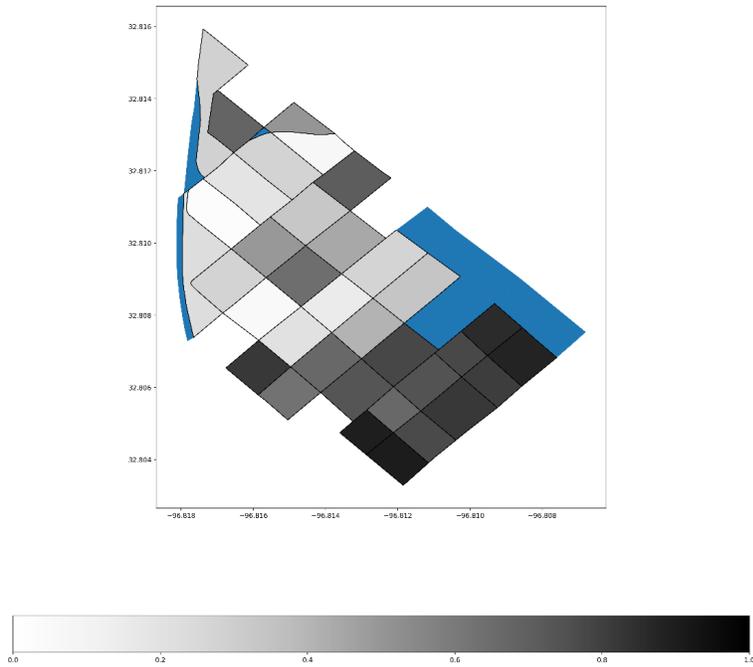
FIGURE 13. *Precinct 1131043 Black and Hispanic Population Concentrations, 2010*



Source: Visual by Author

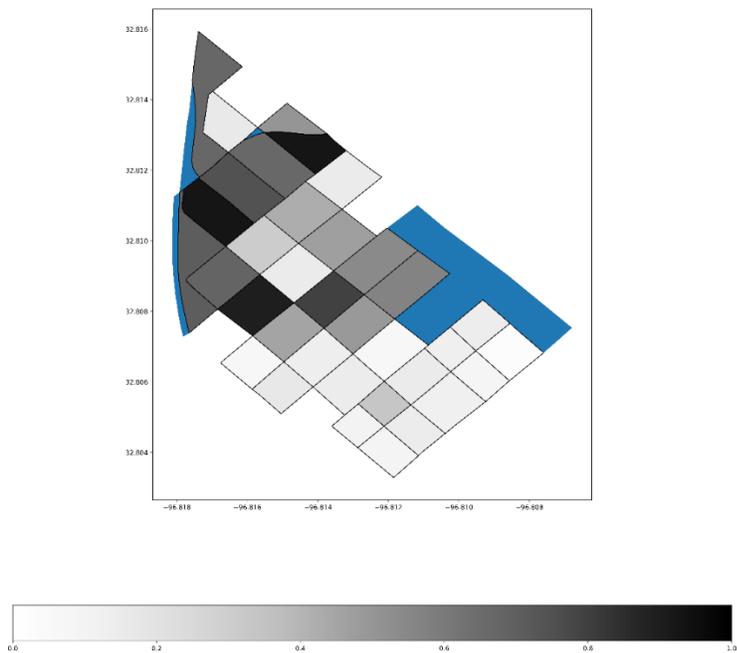
This neighborhood level racial segregation can also be visualized in *precinct 1134032* in Dallas' north central side. Figure 13 and 14 show the population distribution of the white and Hispanic populations in the precinct. Figure 13 shows the blocks that have the most white people while figure 14 shows the blocks that have the most Hispanic people. In Figure 13, the darker census blocks have the highest white fraction while the lighter census blocks have the lowest white fraction. In contrast, In Figure 13, the darker the census blocks have the higher fraction of Hispanic people. The lighter census block have the lower fraction of Hispanic people. Blue indicates no population. From a total population of 4,354 people, this precinct has 1,663 White People; 356 Black people; and 2,202 Hispanic-identifying people. With a white population percentage of about 45%, a black percentage of about 10% and a Hispanic percentage of about 40%, this precinct would also presumably be integrated because of the high representation of white and Hispanic identifying people. However, as shown in Figure 13 and 14, and by the precinct's high deviation score of 31%, it is evident that a large proportion of the precinct's white population lives in one side of the precinct, the lower east side, while a large amount of Hispanic population in the precinct live in upper west side. The black population is not concentrated enough in this precinct for us to decipher where they live. There are many precincts that we identified with this high racial representation and high deviation score including *Precinct 1133808* and *1131052*.

FIGURE 13. *Precinct 1134032 White Population Concentrations, 2010*



Source: Visual by Author

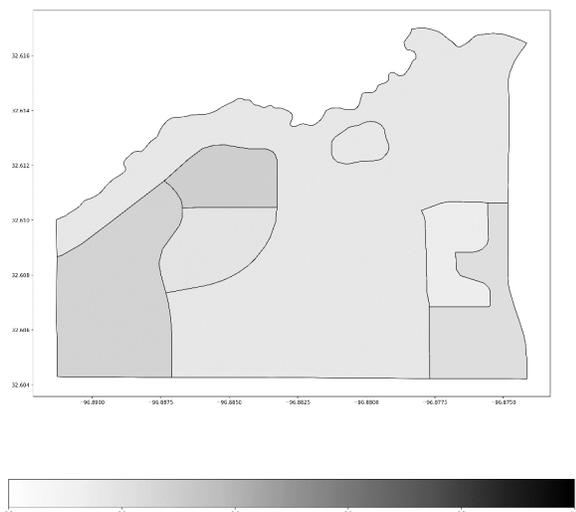
FIGURE 14. *Precinct 1134032 Hispanic Population Concentrations, 2010*



Source: Visual by Author

In contrast, precincts that are integrated within census blocks have a low deviation score because of their similar racial demographics in each block. *Precinct 1133602* in Dallas' far southern side is an example of this integration. From a total population of 692 people, there are 498 black people and 34 Hispanic-identifying people and 135 white people. This means that the precinct's white fraction is right above 20%, the black fraction is about 68% and the Hispanic fraction is about 4%. As shown in Figure 15 and 16, this precinct has a nearly uniform distribution of the black and white populations between census blocks. Figure 15 shows which blocks have the highest concentration of white people while Figure 16 shows which blocks have the highest concentration of black people. There might be a higher concentration of black people throughout this precinct but since the distribution of both white and black people is so even, it points to the strong possibility of racial integration. With a deviation of about 6%, this precinct is below the county average of 17.7% and is visually integrated between census blocks. Because of the high number of white and black people and the low deviation in *precinct 1133602*, this precinct is evidence of racial integration precinct wide and in the census block level.

FIGURE 15. *Precinct 1133602 White Population Concentrations, (2010)*



Source: Image by Author.

FIGURE 16. *Precinct 1133602 Black Population Concentrations, (2010)*

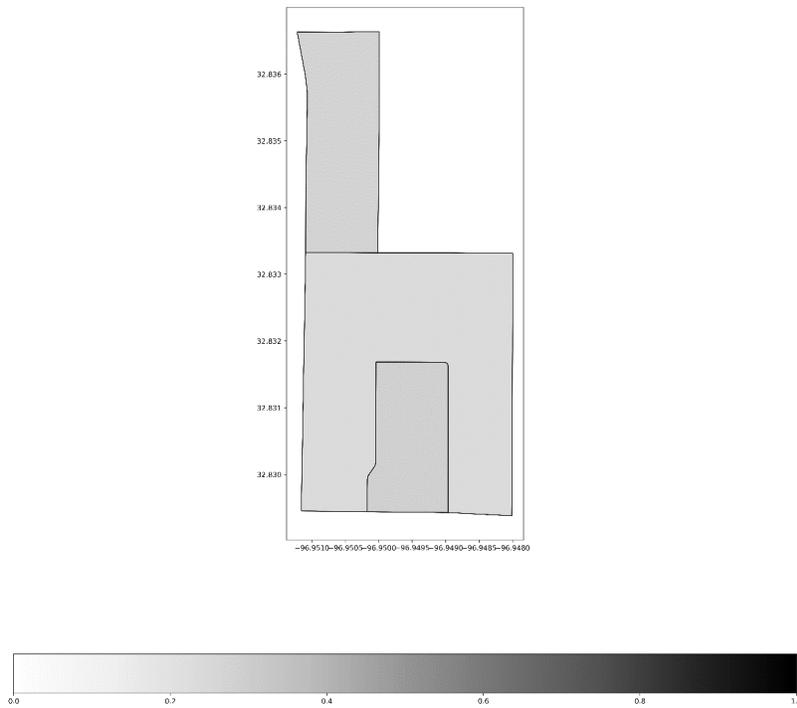


Source: Image by Author.

Similarly, *Precinct 1134615* in Dallas' west side is another example of this integration. From a total population of 491 people, there are 41 black people and 320 Hispanic-identifying people and 122 white people. This means that the precinct's white fraction is right about 30%, the black fraction is about 7% and the Hispanic fraction is about 60%. As shown in Figure 17 and 18, this precinct has a nearly uniform distribution of the black and Hispanic populations between census blocks. Figure 17 shows which blocks have the highest concentration of white people while Figure 18 shows which blocks have the highest concentration of Hispanic people. There might

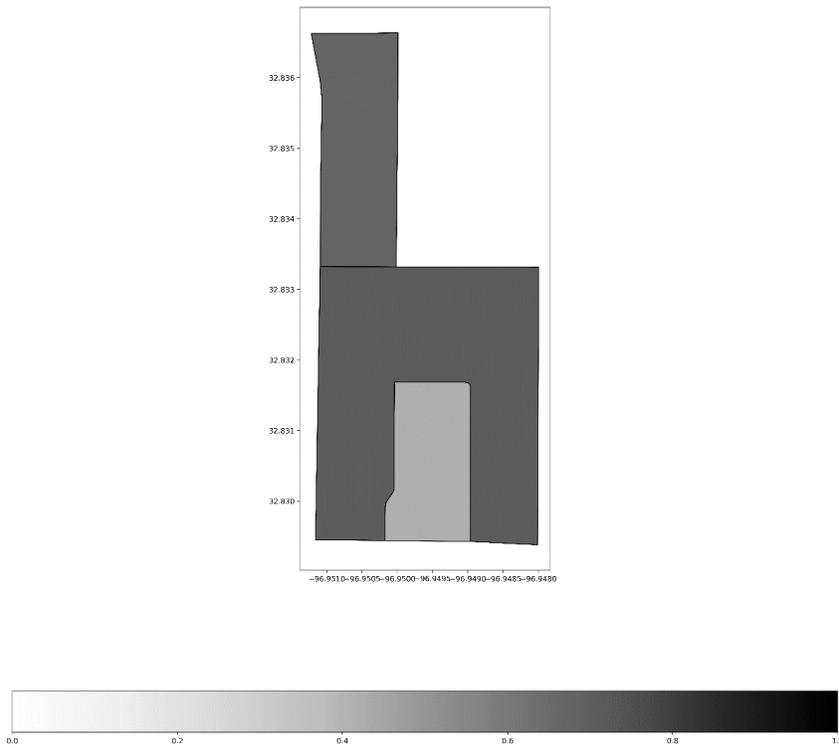
be a higher Hispanic concentration throughout this precinct but since the distribution of both white and Hispanic people is so even, it also points to the strong possibility of racial integration. With a deviation of about 3%, this precinct is below the county average of 17.7% and is also visually integrated between census blocks. Because of the high number of white and black people and the low deviation in *precinct 1134615*, this precinct is evidence of racial integration precinct wide and in the census block level.

FIGURE 17. *Precinct 1134615 White Population Concentrations, (2010)*



Source: Image by Author.

FIGURE 18. *Precinct 1134615 Hispanic Population Concentrations, (2010)*



Source: Image by Author

With our analysis of population distribution in Dallas County, we find that within and between precincts there is evidence of racial segregation. Dallas' north-central side, right above Interstate-30, has more white people while Dallas' south-central side, right below Interstate-30,

has more black people. Within much of Dallas' north-central side in precincts with a higher white population, there tends to be such a low presence of black people that we are unable to identify racial segregation between census blocks in those precincts. Within Dallas' south-central side, there is evidence of racial segregation between the black, white and Hispanic-identifying populations within precincts. This analysis leads to the fact that there is identifiable racial segregation between neighborhoods in Dallas County. Because we have both segregated and integrated regions we can investigate how the demographic of one's neighborhood influences how they vote. We will pursue this study in the proceeding section.

5. Voting Pattern

5.1 Three-Dimensional Analysis of Voting Preferences in Dallas County

As we have seen, there are both segregated and integrated regions in Dallas County. To now understand how levels of segregation influences how people vote we are going to use linear interpolation; i.e. we will assume that each race/ethnicity votes in the same proportion throughout the county no matter where they live. This technique is often used in practice [13]. We will compare the proportions in Dallas County to the state-wide proportions; we will then see how this homogeneous model breaks down and how the demographics of one's neighborhood affects how they vote.

Under the assumption of uniform demographic proportional voting, we can estimate the democratic vote fractions in a region if we know the demographic vote fractions in a larger area. For example, according to CNN's 2010 Gubernatorial election exit poll of 2,715 Texas voters,

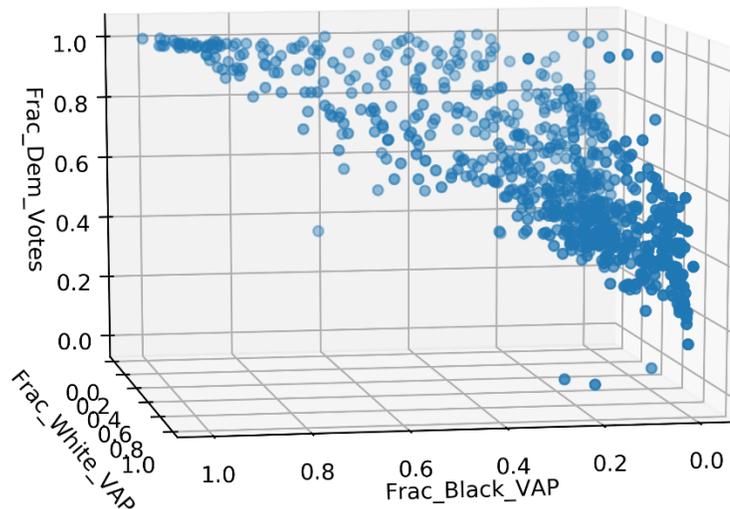
about 29% of Texas' white voters voted for the Democratic candidate, Bill White, and about 69% of this population voted for the Republican candidate, Rick Perry, while the rest either left the question blank or voted other. For the poll's Black population, about 88% voted for the Democratic candidate while 11% voted for the Republican candidate and the rest either left the question blank or voted other. For the Latino population, about 61% voted democratic while 38% voted Republican in this election and the rest either voted other or left the question blank. Assuming this breakdown of CNN's poll is an accurate statewide representation of the voting preference of each race, then we can presume that 29% of Dallas County's white voters voted Democrat, 88% of Dallas' black voters voted Democrat, and 61% of Dallas' Latino voters voted Democrat.

Using these number in our model, if a precinct is made up of 50% white voters, 25% black voters, and 25% Hispanic voters and since $0.5 + 0.25 + 0.25 = 1$, then the fraction of Democratic votes in that precinct is equal to the fraction of white voters, 0.5, multiplied by the fraction that voted Democrat, 0.29, plus the fraction of black voters, 0.25, multiplied by the fraction that voted Democrat, 0.88, plus the fraction of Hispanic voters, 0.25, multiplied by the fraction of the population that voted Democrat, 0.61, predicting a democratic vote fraction of 0.51 or 51%.

$$0.51 = (0.5*0.29) + (0.25*0.88) + (0.25*0.61),$$

But there is no reason to assume that Dallas votes like the rest of Texas. To investigate the difference between the demographic voting patterns in Dallas and in Texas, we use a linear regression model in Dallas county to determine voting patterns within the county.

FIGURE 1. 3D Plot of Voting Preference by Race in Dallas County, 2010



Source: Image by Author

The model assumes that knowing whether someone is black, white, or Hispanic is enough to (probabilistically) determine their voting preference, independent of where they live. This assumption is the baseline for many studies on voting rights act investigations and is well established in practice [4]. The linear regression model is given as

$$\text{DemVF} = \text{BPF} * \text{BDV} + \text{WPF} * \text{WDV} + \text{HPF} * \text{HDV},$$

where DemVF is the Democratic vote fraction, BPF is the black population fraction, BDV is the fraction of the black population voting for the Democratic candidate, and WPF/HPF and

WDV/HDV are similarly defined for white/Hispanic people. Under the assumption that these three demographic groups comprise the vast majority of the population, we may rewrite our model as

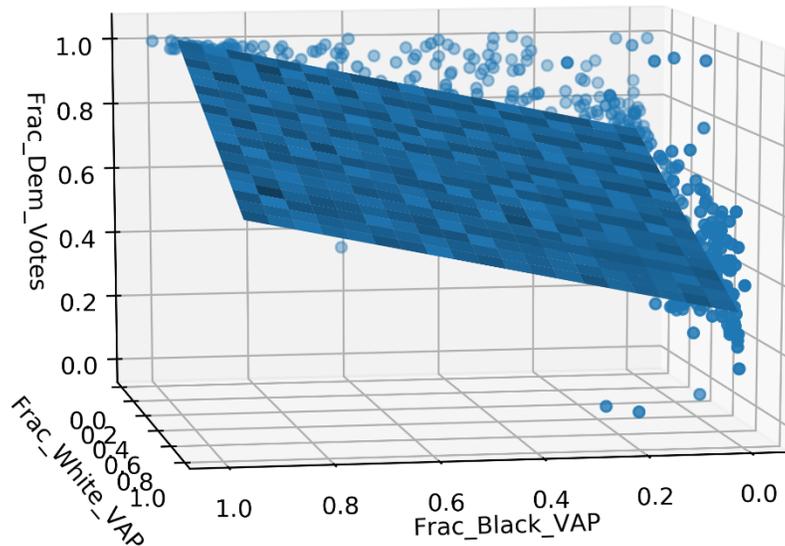
$$\text{DemVF} = \text{BPF} * \text{BDV} + \text{WPF} * \text{WDV} + (1-\text{BPF}-\text{WPF}) * \text{HDV},$$

$$\text{DemVF} = \text{A} * \text{BPF} + \text{B} * \text{WPF} + \text{C},$$

where $\text{A}=(\text{BDV}-\text{HDV})$, $\text{B}=(\text{WDV}-\text{HDV})$, and $\text{C}=\text{HDV}$. In other words, the model maps the black and white population fractions to a predicted Democratic vote fraction. The issue is that we do not know A, B, nor C. To determine them we use a least squares regression analysis to fit them to the precinct level data in Dallas.

This precinct level data is plotted in Figure 1, and the best fit plane is shown in Figure 2. The blue dots indicate each individual precinct. The x axis is each precinct's Black Voting Age Population. The y axis is each precinct's White Voting Age Population. The Z axis is the fraction of Democratic votes in each precinct. Each axis is measured from 0 to 1 – 0 indicates either no population of that race or no votes for the Democratic party. The number 1 indicates either the precinct is made up of that single race or every vote in the precinct was cast for the Democratic party. Adding a plane through this 3D model helps us better view and understand the trend and shows how the model predicts the outcome.

FIGURE 2. 3D Plot of Voting Preference by Race in Dallas County with Plain, (2010)



Source: Visual by Author

The model (a plane) shown in Figure 2 is drawn over the average scatter of the distribution of plots in the visual. We find $A = 0.31$, $B = -0.41$ and $C = 0.70$ which corresponds to the estimates that the black population vote for the Democrats 101% of the time, the white population vote for the Democrats 29% of the time, and the Hispanic population vote for the Democrats 70% of the time. The statewide level of Democratic votes estimated by the CNN poll finds that the black population vote for the Democrats 88% of the time, the white population vote for the Democrats 29% of the time, and the Hispanic population vote for the Democrats 61% of the time. As evident by our model, the more black people live in a precinct the more likely the precinct voted

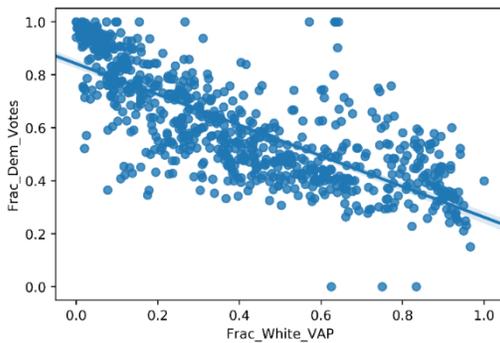
Democrat, and the more white people live in a precinct the less likely the precinct voted Democrat. To better understand this relationship between race and voting pattern, we visualize Black and White voting preferences projected down to showing only the population fractions of just two demographics in 2D plots.

We note that it is impossible that over 100% of a population votes for a particular party; however, the fact that the model predicts this is an indication that as non-black people live with black people, they may tend to vote more Democratic. We explore this hypothesis further below.

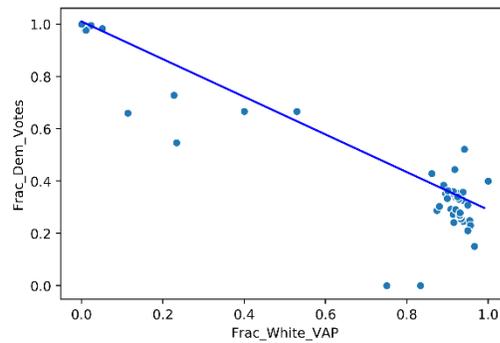
5.2 Analysis of Voting Preferences in Dallas County

FIGURE 3. Plot of White Voters to Democratic Votes with Regression Line, (2010)

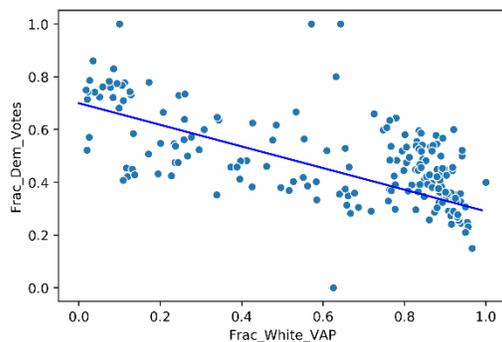
1. All Precincts



2. White/Black Precincts (Hispanic VAP below 5%)



3. White/Hispanic Precincts (Black VAP below 5%)



Source: Visual by Author

To show the relationship between White VAP and voting preference within the County, we create a scatterplot comparing the white VAP fraction to Democratic votes. We start by analyzing the distribution of every precinct in the county with Figure 3.1. We then analyze the distribution of precincts with nearly all white and black people with Figure 3.2 – Hispanic population less than 5% of the total precinct population. And, precincts with only white and Hispanic people with Figure 3.3 – Black population less than 5% of the total precinct population. The two scatterplots, Figure 3.2 and 3.3, depicting the precincts with mostly the white population and one other demographic group provides us with a better understanding of how the existence of a second racial group changes the voting preference of the white population.

Figure 3.1 depicts the relationship between the white VAP and Democratic votes in every precinct in the county. The least squares regression line cutting the scatterplot near the center is a line of best fit that shows the trend of white VAP to Democratic votes. As the number of white people living in a precinct increases, the fraction of votes cast for the Democratic candidate decreases. There is a negative correlation between both variables. As shown by the figure, in relatively integrated precincts, where the fraction of the white VAP is between 0.35 and 0.65, there is a high number of precincts that vote below the regression line indicating that precincts with a high number of white people and a second race, or ethnic group, lean more Republican than expected. In these precincts, the influence of the heavy Democratic leaning black population is much lower than the influence of the heavy Republican leaning white population. This means that either the integrated populations are willing to vote more Republican because of the influence of the white population or there are so few high black, high white precincts that the

integrated precincts are mostly high white and high Hispanic, indicating their preference to vote Republican. Since there is a higher number of people voting Democratic when those precincts comprise more black people, the white and black voting preference of these integrated precincts are presumably split in such a way that marks evidence for polarization in demographic voting preference. While the smaller black populations in these precincts presumably are voting Democrat, the high white (and possibly high Hispanic) populations are voting against the political preference of the black population creating this high number of Republican leaning integrated precincts.

There is a heavy cluster of precincts above the regression line in the below .20 white population precincts, indicating those precincts with high black and/or Hispanic populations seem to vote higher for the Democratic candidate than expected. In these precincts, there is a higher number of Democratic leaning black and Hispanic people than Republican leaning white people. Leading to either the black population pushing the Hispanic population to vote Democratic or the lack of white Republican leaning representation in the precincts pushing the precincts to lean more Democrat. These precincts could also be made up of mostly black people or comprised of mostly Hispanic people. According to our earlier estimate of the County wide black population Democratic voting percentage of 101%, it can be assumed that these precincts that lie much over the regression line are mostly made up of a high fraction of black people.

When measuring the white voters in a precinct and comparing that to the number of Democratic votes in that precinct, looking only at precincts with a maximum Hispanic population of 0.05 provides us information on the number of white/black integrated precincts and how those precincts like to vote. Figure 3.2 plots this relationship. As evident by the lack of precincts in the integrated region of the plot, there is a low number of precincts that have

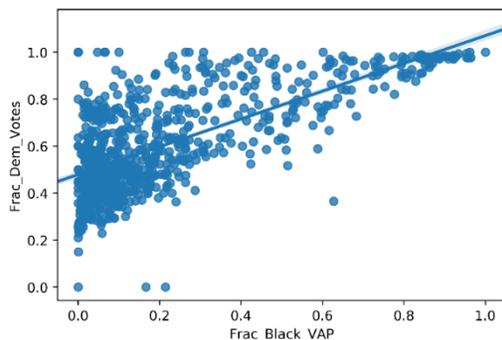
integrated white and black populations. The few precincts with a white voting fraction between 0.10 and 0.60 all have a preference for the Democratic party below the regression line. These integrated white, black precincts all leaning Republican than what is expected reveals that the few white, black integrated precincts tend to prefer the Republican party. Since there is such a low number of precincts making up this area of the scatterplot, just 4 precincts, it would not be helpful for our analysis to make a preliminary conclusion about the relationship between the population fraction and voting preference of these precincts. In more heavily white areas, the precincts lean considerably more Republican; while in the less white precincts – precincts with black and Hispanic populations making up near 100% of the population – lean heavily Democrat. The regression line depicts the expected voting preference of the county if there were no Hispanic voters. Since the white heavy and white light areas of the scatterplot correlates with the regression line, the line provides an accurate representation of voting trend in areas that are either heavily white or heavily Black. The depicted data agrees with the expected result, that heavily black areas lean Democratic while heavily white areas lean Republican. The fact that there are only a few black/white precincts means that high integration between just the black and white populations in this county is very low.

In Figure 3.3, we look now at the White population's voting preference in precincts where the Black VAP is below 0.05. There is a much higher number of white/Hispanic precincts in the integrated region of this scatterplot than the integrated region of Figure 3.2. This higher number of white/Hispanic integrated precincts indicates that the precincts we earlier identified as integrated in Figure 3.1's .35 to .65 region is most likely comprised of more white/Hispanic integration than white/Black integration. Figure 3.2's low number of white/black integrated precincts, Figure 3.3's high number of white/Hispanic integrated precincts, and Figure 3.1's

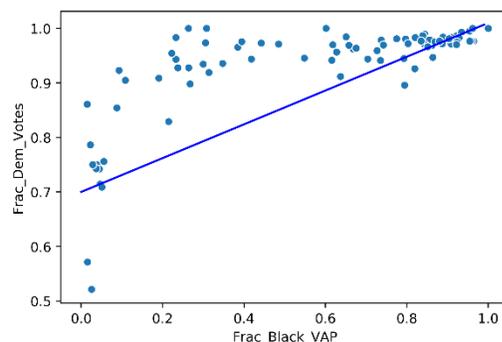
Republican skew in its integrated region reveals that a majority of the County's integrated precincts are white/Hispanic integrated and these precincts vote more Republican than expected because of the political absence of black people. This confirms our earlier hypothesis that this Republican lean in integrated precincts is because of the lack of the political influence of the Democratic leaning black population. There is so few high black/white precincts that the integrated precincts are composed of mostly the Republican leaning white population, leading to the Hispanic populations higher willingness to vote Republican within these precincts. There is also a lower number of Democratic votes within these integrated precincts because of the lower level of black people. The regression line that cuts the scatterplot near the center shows the average of how precincts with varying populations of white and Hispanic people vote. This plot's regression line is downward sloping but not as steep as the regression line in Figure 3.2, indicating that white and Hispanic populations are less polarized in their voting preference. In the heavy white region, above 0.75 white people, there is a clustering of precincts with a fraction of democratic votes near 20% to 60%, indicating that when a precinct is made up of a heavy white population with the existence of Hispanic people, the precinct leans more Republican.

FIGURE 4. Plot of Black Voters to Democratic Votes with Regression Line, (2010)

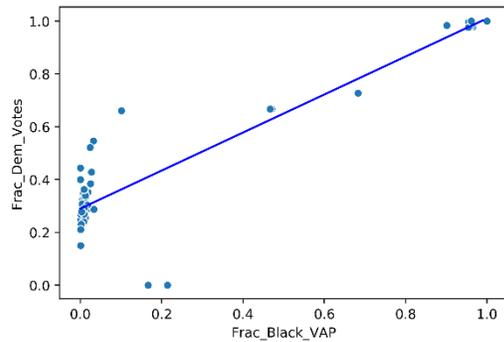
1. All Precincts



2. Black/Hispanic Precincts (White VAP below 5%)



3. Black/White Precincts (Less than 5% Hispanic VAP)



Source: Visual by Author

To further understand voting preferences for integrated and segregated precincts, we plot the relationship between the fraction of the black voting age population in every precinct and the fraction of people in those precincts who voted Democratic in the election in Figure 4.1. We then graph precincts with no more than a 5% white VAP to identify a relationship between voting preference and majority black/Hispanic populations in Figure 4.2. To identify a relationship between black/white precincts – precincts with a Hispanic VAP below 5% – in Figure 4.3. In each figure, it is evident that as the fraction of black VAP increases, the fraction of Democratic votes in the precinct increases, meaning there is a positive correlation between number of black people living within an area and the number of votes cast for the Democratic party. When a precinct is comprised of a higher Hispanic/white population than black people, as depicted in Figure 4.1, the precinct has proportionally less people vote Democratic than Republican. The least squares regression line that cuts Figure 4.1 near the center shows how Democratic votes change as the fraction of black VAP increases. The line is used to predict Democratic vote

proportion for a given fraction of black VAP. The regression lines that cuts Figure 4.2 and 4.3 near the center is an estimate of the county wide voting trend for both black/Hispanic precincts and black/white precincts, Figure 4.2 and 4.3 respectively, as provided by our earlier estimate of Dallas County's demographic voting preference of white = 29%, black = 101% and Hispanic = 70% for the Democratic party.

As indicated by Figure 4.1, in relatively integrated precincts, where the fraction of the black VAP is between 0.35 and 0.65, there is a low number of high black and high a second race precincts. Compared to the number of precincts with either a very low black population, below 20%, or a very high black population, above 80%, there are few precincts with a high black plus high a second demographic group. This comparative lack of integrated black precincts indicates that integrated precincts have a high number of white and Hispanic people as opposed to high white and black or high Hispanic and black people. This lack of black integration affirms our previous idea that integrated precincts lean more Republican because of the higher number of white and Hispanic integrated precincts than white and black integrated precincts, and in those precincts with a comparable size of white, Hispanic and black people, there is a strong chance that the black population is voting one way (Democrat) while the rest of the population is voting another (against the Democrat/for the Republican), pointing to signs of racial polarization in voting preference.

The scatter but still consistent upward trend in the integrated precincts region shown in Figure 4.1 indicates that precincts with a high population of black people lean Democrat. Considering the high Republican skew in the integrated region of Figure 3.1, this Democratic lean for black integrated precincts also supports the idea that the higher Republican preference of Figure 3.1's integrated region is due to both a higher number of white/Hispanic precincts than

white/black precincts and polarization within precincts of the Republican leaning white population and the Democratic leaning black population.

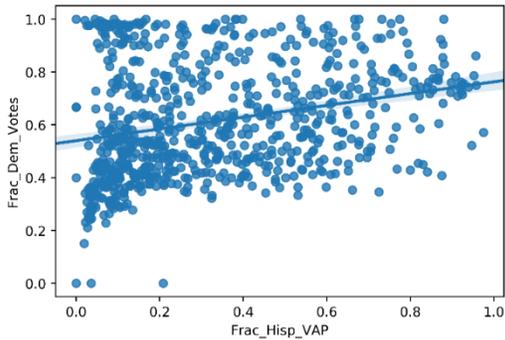
Figure 4.2 shows the relationship between the precinct's black VAP fraction and the precinct's Democratic vote fraction. Plotted are precincts that have a white voting age population fraction less than 5%. This means that the graph only shows precincts with a very low white population and with some level of Black people mixed with some level of Hispanic people. The figure is indicative that as the fraction of the voting age population increases by precinct, the fraction of people within those precincts voting democratic increases considerably. It is significant that the y-axis starts at 0.50 because it shows that the precinct with virtually all Hispanic people had the lowest fraction of people who voted for the Democratic candidate even though this precinct is voting Democratic at a fraction still preferable for the Democratic candidate, over 0.50. The regression line drawn in the Figure 4.2 lying below all the precincts with a black VAP of 0.15 to 0.60 is indicative that the black/Hispanic integrated precincts – precincts with very little to no white people – lean Democratic considerably higher than what is expected from our earlier county wide estimate. This figure also supports the idea that when Hispanic people live with white people, they vote slightly more Republican while when they live with black people, they vote significantly more Democratic.

When controlling for the Hispanic population – capping their population within precincts at 5% – there is evidently a low number of black/white integrated precincts. This low black/white precinct number supports the argument that there are only a few areas that have considerable integration between the black and white populations within the County. With only two precincts having a black population near 60% and a high white population of some number, you would be hard pressed to find highly integrated black and white areas in the County without some presence

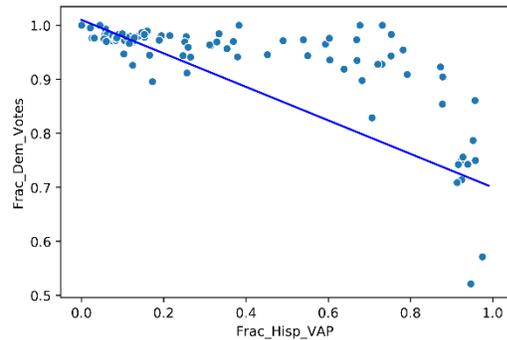
of Hispanic people while it would be much easier to find integrated white and Hispanic areas without much of a presence of black people. As evident by the cluster of precincts in the high black VAP/high Democratic votes and low black/low Democratic votes portions of Figure 4.1, and 4.3, when a precinct is composed of mostly black people they lean heavily Democratic while when a precinct is composed of much fewer black people and a high number of white people, the precinct leans strongly Republican, reaffirming the polarization in black and white political preference we identified earlier.

FIGURE 5. Plot of Hispanic Voters to Democratic Votes, (2010)

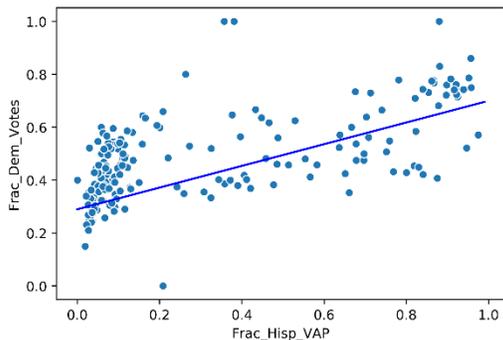
1. All Precincts



2. Hispanic/Black Precincts (White VAP below 5%)



3. Hispanic/White Precincts (Black VAP below 5%)



Source: Visual by Author

Figure 5.1 depicts the relationship between Hispanic VAP and voting preference in every precinct. Figure 5.2 depicts the relationship between the Hispanic VAP and voting preference of Hispanic/black precincts – precincts with a white VAP fraction below 5%. Figure 5.3 depicts the relationship between the Hispanic VAP and voting preference of Hispanic/white precincts – precincts with a black VAP fraction below 5%. The positive trend of the least squares regression line in Figure 5.1 reveals that the Hispanic population leans slightly Democrat, but their Democratic lean is not nearly as steep as the black population’s Democratic lean depicted in Figure 4.1. The regression lines on Figures 5.2 and 5.3 is the depiction of our earlier county wide voting estimates.

Figure 5.1 shows the relationship between the fraction of Hispanic-identifying VAP in a precinct and the fraction of the people in those precincts who vote for the Democratic candidate. This scatterplot shows that as the fraction of the Hispanic VAP increases, the fraction of people voting democratic increases. The regression line shows a positive trend in the relationship between Hispanic populations in precincts and Democratic voting preference, but the slope is not as steep as figure 4.1, indicating that the Hispanic populations might prefer the Democratic candidate but as a population they are less universally Democratic leaning than the Black population. As the fraction of Hispanic VAP increases from 0 to 0.20, there is a significant nearly linear increase of the fraction of Democratic votes. Because of the relative low number of integrated Black and White precincts – as shown in Figure 4.1 – the high number of precincts comprised in Figure 5.1’s integrated region – between 0.25 and 0.65 – tells us that Figure 3.1’s high number of precincts below the best fit line are composed of mostly Hispanic and white

people. Figure 5.1 also tells us that precincts with a lower Hispanic VAP are split. There is a high concentration of precincts in the scatterplot's low Hispanic VAP fraction, high Democratic vote fraction and low Hispanic VAP fraction, low Democratic vote fraction areas. This separation is presumably because of the higher number of Democratic leaning black VAP in the precincts with high Democratic voting fractions and the Republican leaning white VAP in the precincts with low Democratic voting fractions. This trend of polar voting fractions is consistent as the Hispanic population increases, even though as a population they have a slight Democratic lean.

Figure 5.2 is possibly the most significant scatterplot depicted. This scatterplot shows the relationship between the Hispanic VAP fraction and the Democratic vote fraction in Hispanic/black precincts within the county – precincts with a white population below 5%. The regression line in this scatterplot shows the fit of the earlier estimate of the County's Democratic votes depending on the Hispanic and black population fractions. This figure is the inverse of Figure 4.2 and provides clear evidence that even with the Hispanic population's already Democratic lean in their voting preference, the existence of the black population pulls them so far Democratic that any less black people per precinct would only mean less votes for the Democratic party. The fact that every precinct between 0.40 and 0.85 Hispanic VAP fraction is above the regression line supports the idea that the black population in Hispanic/black precincts leads the Democratic voting fraction to a considerably higher fraction than we estimated with the regression line.

As earlier identified, the greater the black population in precincts throughout Dallas county the greater the Democratic vote fraction within those precincts. The fact that integrated precincts are composed of more white/Hispanic people than white/black or Hispanic/black people means

there is a skew in integrated precincts to lean Republican even though the black population consistently votes Democrat. Not only do we find evidence of low integration between the black population and any other Demographic group, Figures 4.1, 4.3, 3.1, there is also evidence of political polarization of the black and white populations within precincts leading to the Hispanic population voting more with whichever population is higher in their area, Figures 3.1, 4.1, 4.2, 5.1, 5.2.

6. Conclusion

The goal of this research was to use voting and demographic data to identify if varying levels of racial segregation and integration affects voting preference. (i.e. how do your neighbors affect how you vote). Using aggregate data, we draw a conclusion about race and voting preference in Dallas County. Voting preference in Dallas is highly correlative with Dallas' racial/ethnic demographic distribution. South-central Dallas votes very Democratic and has a high concentration of black residents. West-central Dallas votes Democratic and has a high concentration of Hispanic residents. North-central Dallas leans Republican and has a high concentration of white residents. In this research, we demonstrate how the Hispanic population votes when there are very few to no white people living in a neighborhood. In these areas, a small black population may polarize Hispanic voters to lean heavily Democratic. Therefore, the political preference of the Hispanic population is pulled either more Democratic or less Democratic depending on their neighbors.

6.1 Implications

Inferring Micro-level Behavior

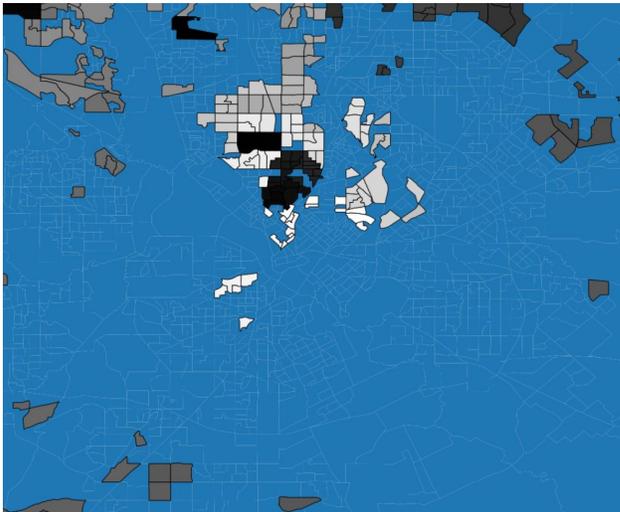
The National Voter Registration Act requires voters to disclose their race when registering to vote. After elections however, demographic information is not released with election results. This means that to understand how a person's race relates to how they prefer to vote, we are only able to use precinct level election results and precinct level census demographic data to draw conclusions about race and voting preferences. This method of using aggregate data to draw a conclusion at the individual level is often used to understand micro-level preferences. Ecological inference is using aggregate data and information at the macro-level to draw conclusions at the micro-level. When no individual level data exists, like the relationship between a person's race and how they prefer to vote, such information needs to be inferred. The need to understand individual and neighborhood level behavior with aggregate data and deterministic information is faced by researchers in fields ranging from political science to economics to sociology.

Resource Allocation

Inferring individual level behavior with aggregate data can also inform how governments decide to allocate resources. Since, through our analysis, a relationship between race and voting preference in Dallas County can be drawn and there is clear separation between economic opportunity in Dallas' southern side versus northern side – with individuals in the north having a higher median household income, closer proximity to retail, and the south having miles of food deserts – the racial foundation that creates these inequalities can be objectively viewed and policies to address this type of economic disenfranchisement can then be more adequately developed and effectively prescribed.

Economic Opportunity

Figure 1. Median Household Income Map in Dallas County



Source: Visual by Author (2019)

Demographic distribution can also inform economic opportunity. As depicted in *Figure 1*, the areas that are not blue indicates census tracts where there is a median household income over \$100,000. The darker the census tract, the higher the median household income. As evident by the map, south-central Dallas has 5 census tracts with a median household income above \$100,000 while north-central Dallas has a higher concentration of precincts with median household income above \$100,000. This map reveals that there is a relationship between the racial demographic makeup of Dallas and income level in the county. This relationship can be further explored. Combining median household income, location of food deserts, and proximity

to retail, conclusions about race and economic opportunity can be drawn. This can then inform the creation of opportunity zones and potential areas of reinvestment.

Predicting future Elections

With our analysis of race/ethnicity and voting preference, accounting for shifting demographics through migration, we can have some idea of the potential political preference of entire communities throughout Texas. With similar demographic and voting information we can draw some conclusion on the relationship between race and voting in different regions of Texas. By just having demographic information of voters and the location where they live, we can draw conclusive results about race and voting preference in more areas of Texas which means we can potentially have the capability to predict future voting preferences with just a few data points. This can then be a powerful tool in creating more accurate predictions of future elections.

Partitioning of Districts

Keeping communities of interest together while partitioning districts is often a state by state mandate in redistricting. Not packing or cracking minority voters to dilute their vote on surrounding districts is also a mandate in redistricting. The creation of minority opportunity districts is also a redistricting mandate through the Voting Rights Act of 1965. With evident political preference of racial/ethnic demographic clusters, the question of how districts should be effectively partitioned can now be more informed.

6.2 Limitations

1. We use Voting Age Population, and assume 100% voter turnout, rather than total population which can potentially skew our ‘neighborhood’ numbers because a neighborhood is comprised of more people than just people over the age of 18.
2. We do not account for races/ethnicities outside of white, black and Hispanic which can potentially skew our voting preference numbers. A potential high exitance of Asian or Native populations in some areas of Dallas County would mean black voters might be affecting Asian or Native populations rather than Hispanic populations.
3. Only Texas’ 2010 Gubernatorial Election results were used in our research. With updated population numbers through the 2020 census, we can possibly draw a different conclusion about segregation in Dallas County.
4. No third-party preference information was considered.

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