Political Data Science Interview Challenge

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Project Outline

Data Collection

Data Preprocessing

Exploratory Data Analysis

Modeling

Summary and Future Work

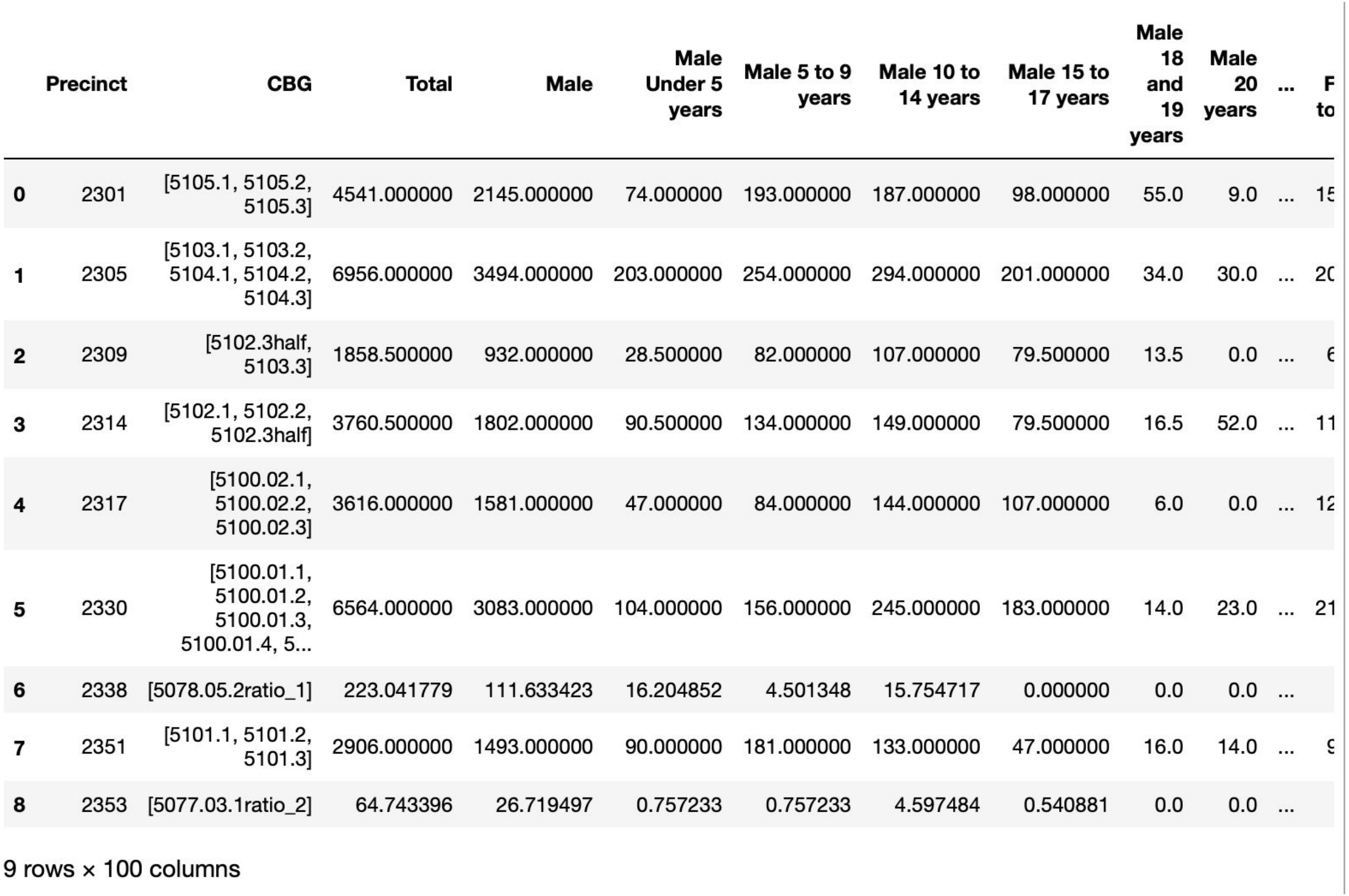
Data Collection

For the City of Los Altos:

- Voting Data (Precinct Level)
- Census Data (Block Level)
    - SEX BY AGE
    - SEX BY AGE (WHITE ONLY)

Data Preprocessing

- Join the data by transforming block level census data to precinct level census data
  - Not 100% accurate mapping >> use ratio to get estimated census data for that precinct, ratio = registered voters/Above 18 years population.
- Clean the data frame
  - Strip out the white space before column names
  - Change the data type from string to integer/float for future calculations
- Merge the census data and voting data into one data frame



	Precinct	CBG	Total	Male	Male Under 5 years	Male 5 to 9 years	Male 10 to 14 years	Male 15 to 17 years	Male 18 and 19 years	Male 20 years	...	F to
0	2301	[5105.1, 5105.2, 5105.3]	4541.000000	2145.000000	74.000000	193.000000	187.000000	98.000000	55.0	9.0	...	15
1	2305	[5103.1, 5103.2, 5104.1, 5104.2, 5104.3]	6956.000000	3494.000000	203.000000	254.000000	294.000000	201.000000	34.0	30.0	...	20
2	2309	[5102.3half, 5103.3]	1858.500000	932.000000	28.500000	82.000000	107.000000	79.500000	13.5	0.0	...	6
3	2314	[5102.1, 5102.2, 5102.3half]	3760.500000	1802.000000	90.500000	134.000000	149.000000	79.500000	16.5	52.0	...	11
4	2317	[5100.02.1, 5100.02.2, 5100.02.3]	3616.000000	1581.000000	47.000000	84.000000	144.000000	107.000000	6.0	0.0	...	12
5	2330	[5100.01.1, 5100.01.2, 5100.01.3, 5100.01.4, 5...	6564.000000	3083.000000	104.000000	156.000000	245.000000	183.000000	14.0	23.0	...	21
6	2338	[5078.05.2ratio_1]	223.041779	111.633423	16.204852	4.501348	15.754717	0.000000	0.0	0.0	...	
7	2351	[5101.1, 5101.2, 5101.3]	2906.000000	1493.000000	90.000000	181.000000	133.000000	47.000000	16.0	14.0	...	9
8	2353	[5077.03.1ratio_2]	64.743396	26.719497	0.757233	0.757233	4.597484	0.540881	0.0	0.0	...	

9 rows × 100 columns

Exploratory Data Analysis

1. Voting Data

    1.1 Total Votes

    1 .2 Mail Votes Percent

2. Census Data

    2. 1 Population Number

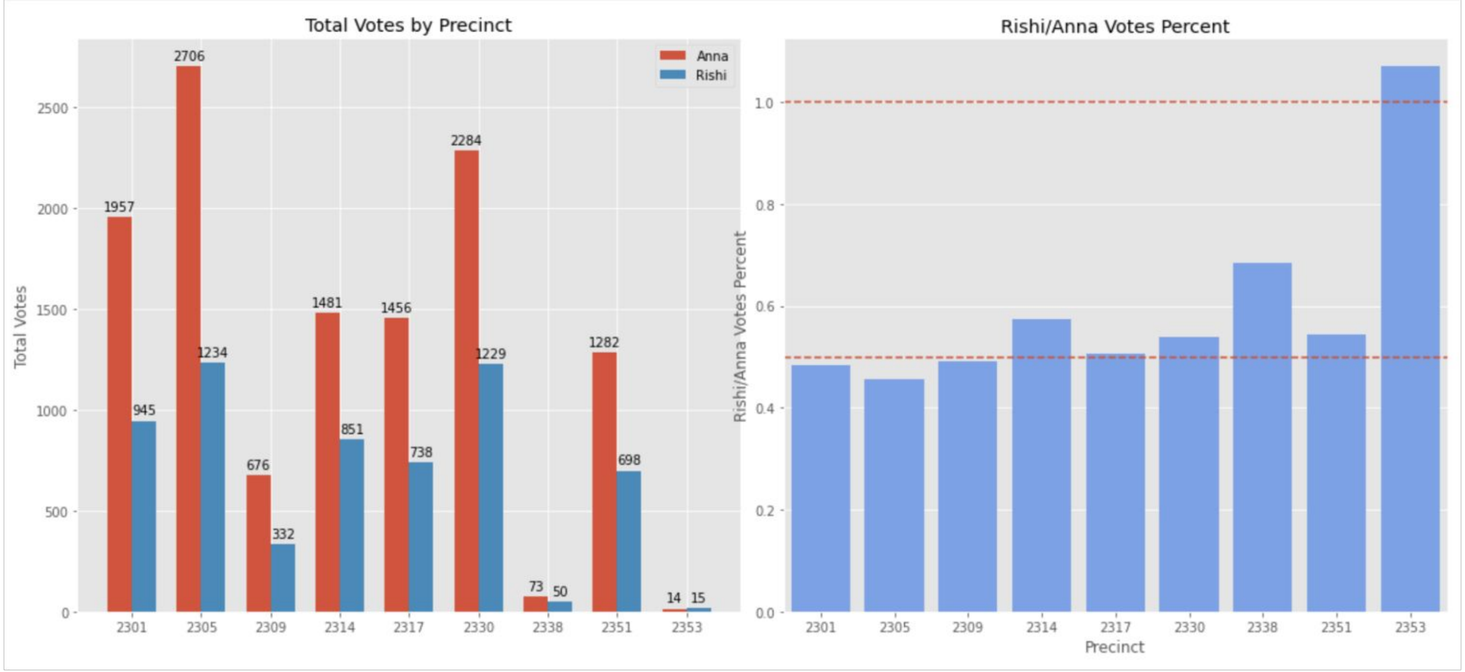
    2. 2 Gender

    2.3 Age Distribution

    2.4 Race (white）

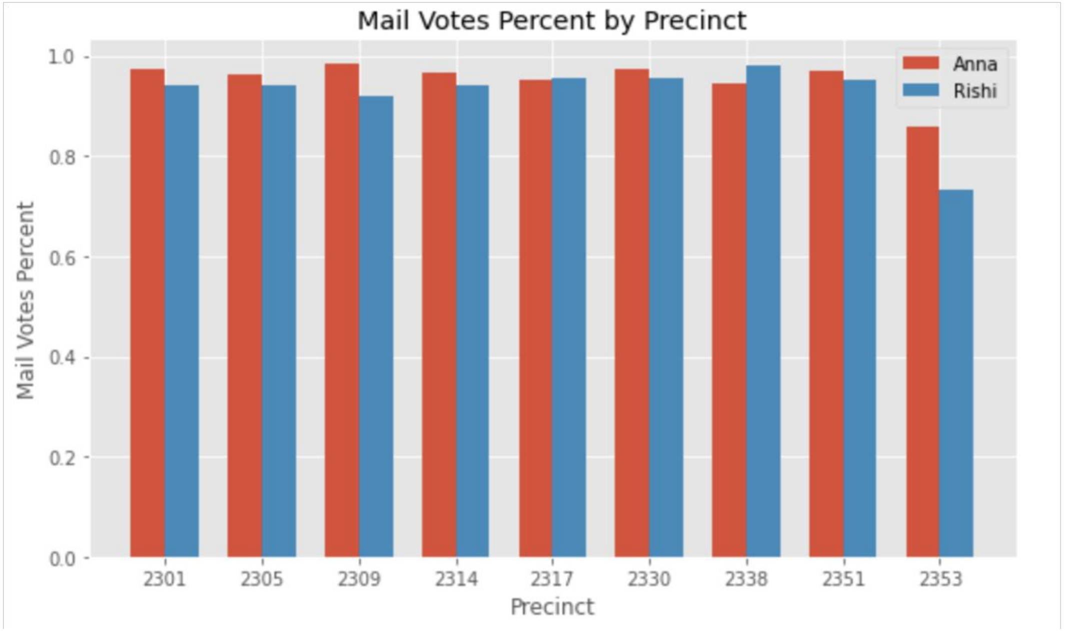
1. Voting Data

1.1 Total Votes by Precinct



- Anna won in every precinct except 2353
- 2314, 2330, 2338, 2351, has percent > 0.5

1.2 Mail Votes Percent by Precinct

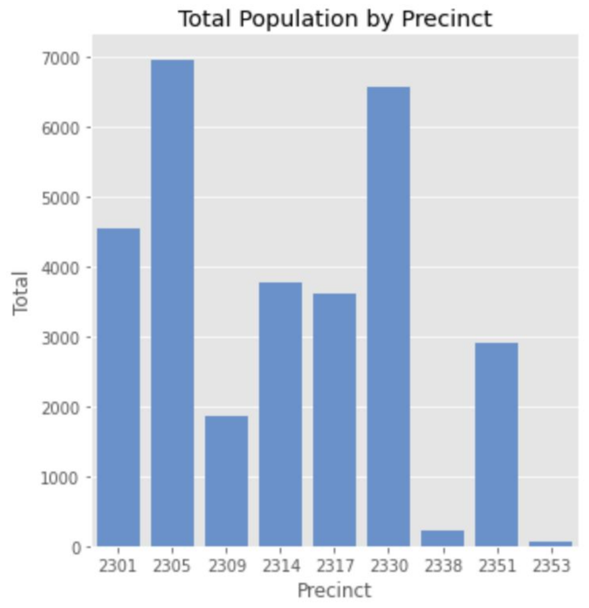


- Anna’s Mail Votes Percent is larger in every precinct except 2338
- Democrats are more likely to mail their votes

2. Census Data

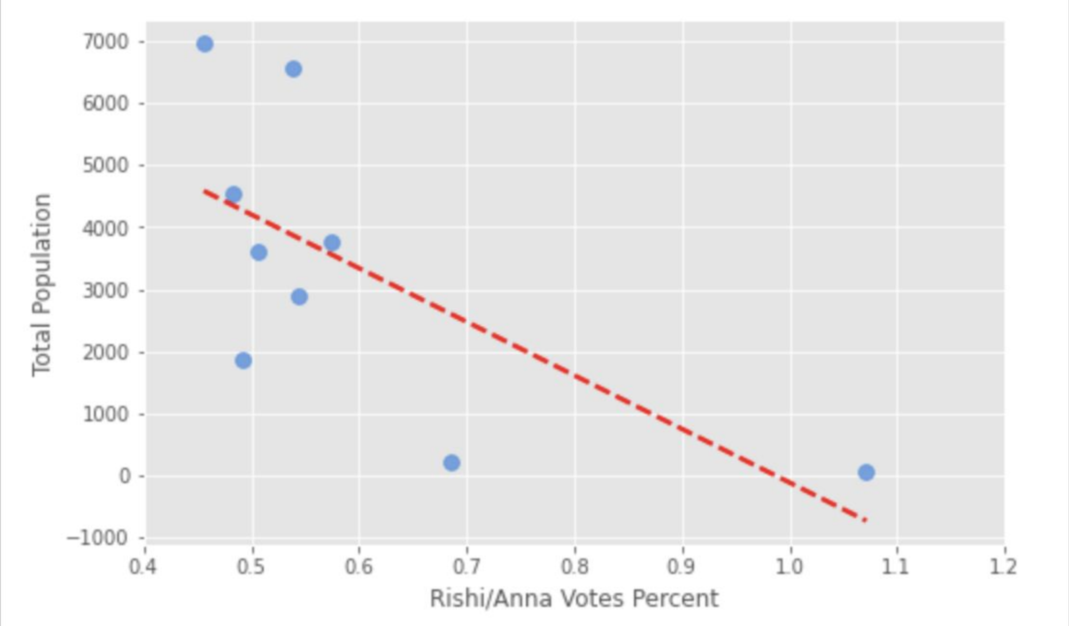
2.1 Census Data (Population Number)

Total Population by Precinct



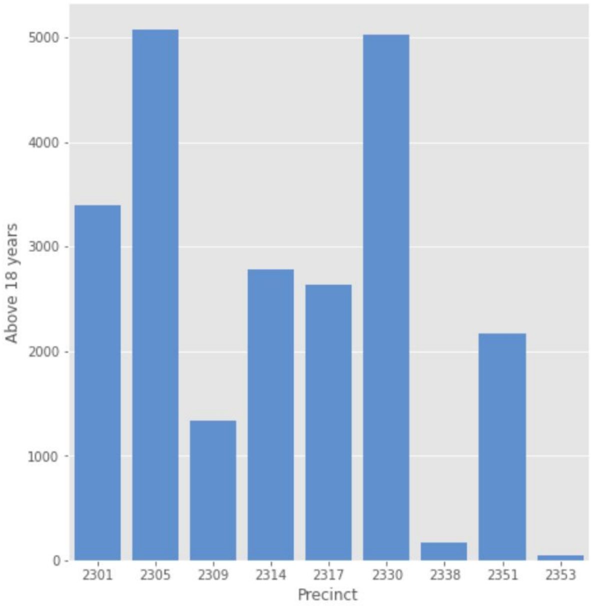
- 2305, 2330 have the largest population
- 2338, 2353 have the smallest population

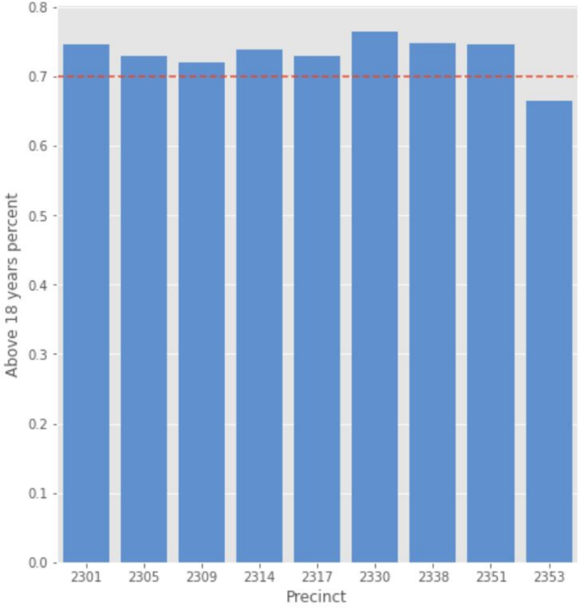
Total Population and Votes Ratio

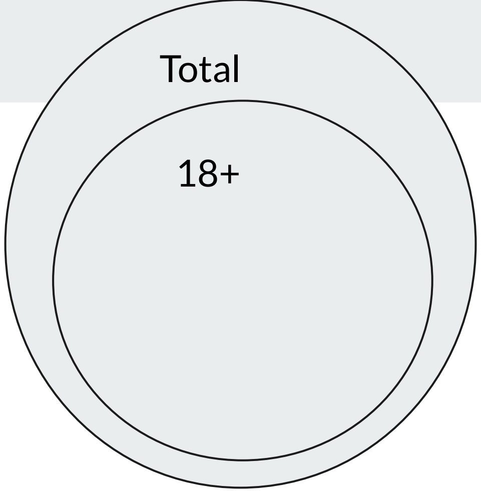


- Negative Slope

Above 18 years Population by Precinct

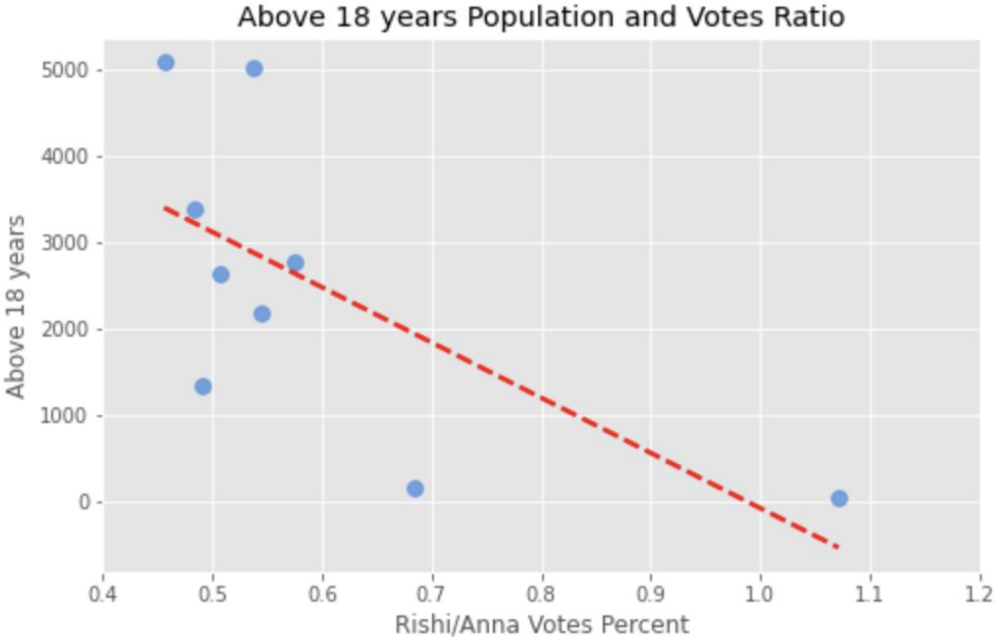






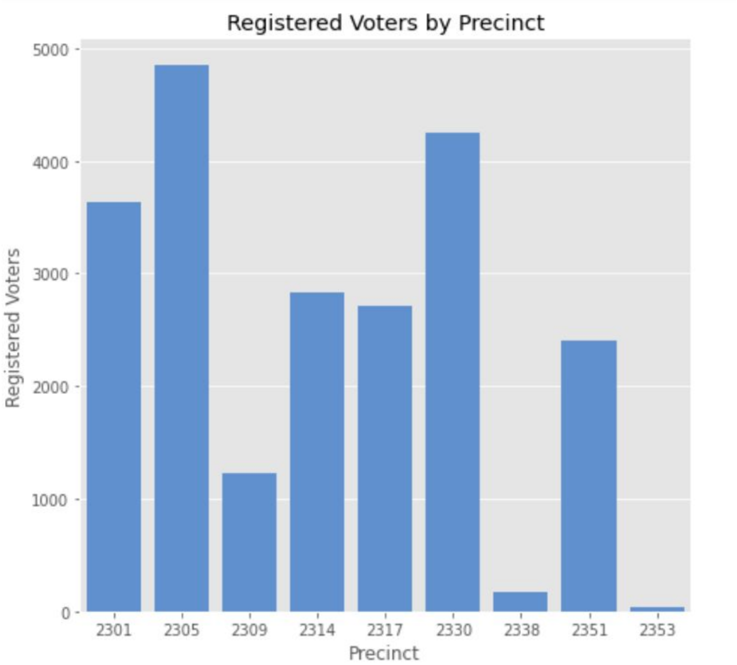
- Similar Pattern with Total Population by Precinct; the relative difference between 2305 and 2330 is smaller here because 2330 has the highest percent
- All the percents are between 0.7 and 0.8 except 2353

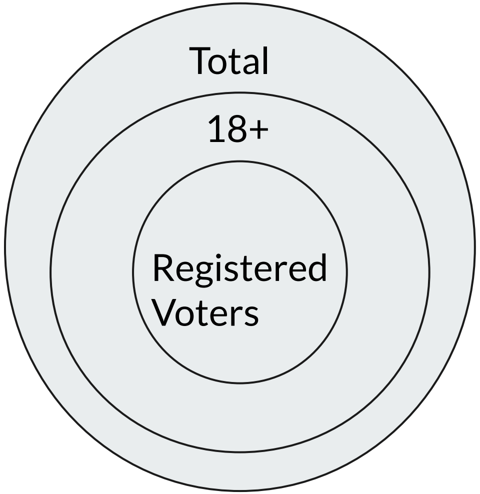
Above 18 years Population and Votes Ratio



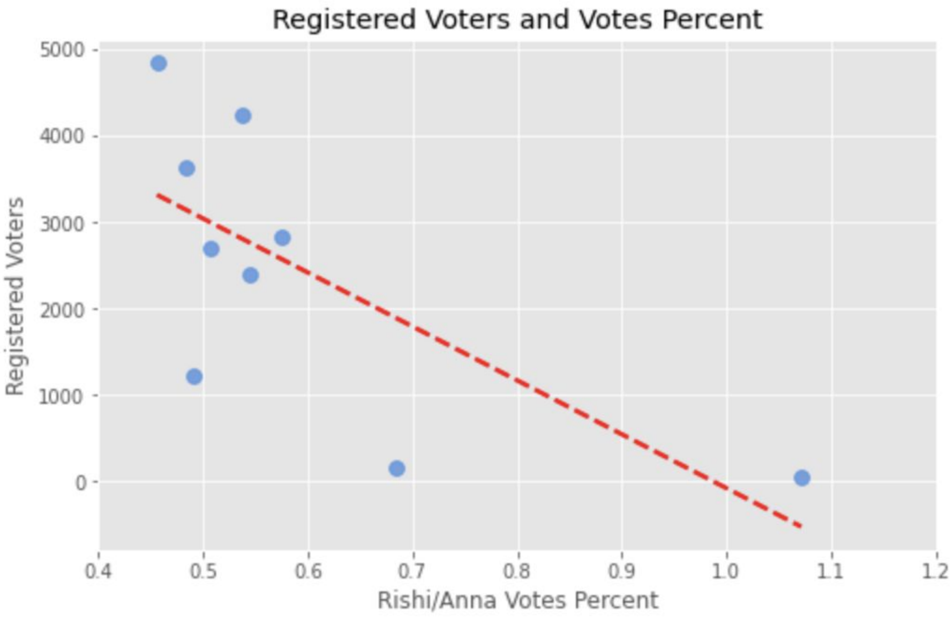
- Negative Slope
- Similar to Total Population

Registered Voters Population by Precinct



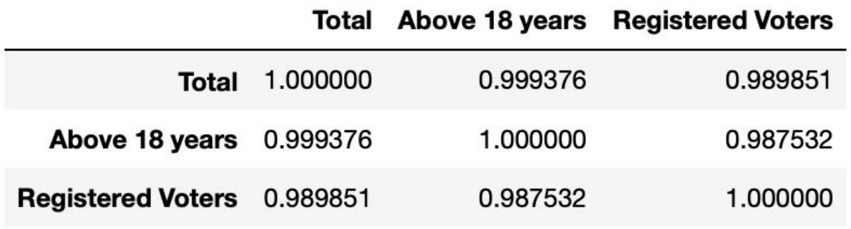


Registered Voters and Votes Ratio



- Negative Slope
- Similar Pattern Again

Total Population, 18+, and Registered Voters



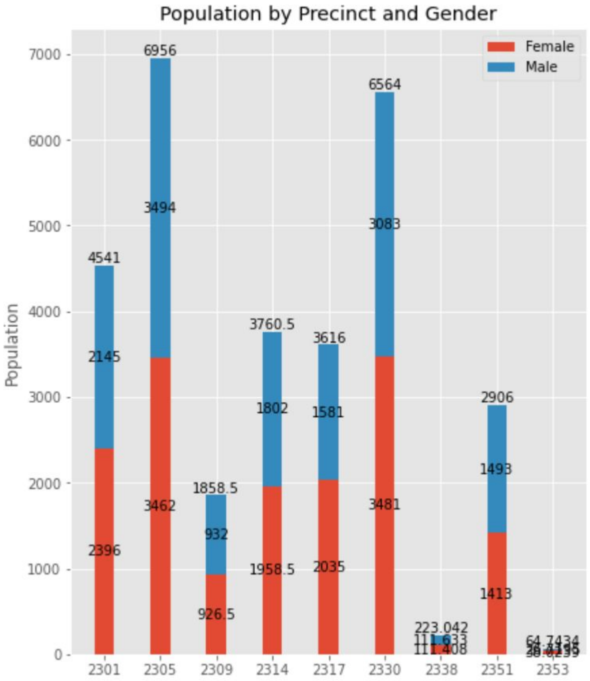
	Total	Above 18 years	Registered Voters
Total	1.000000	0.999376	0.989851
Above 18 years	0.999376	1.000000	0.987532
Registered Voters	0.989851	0.987532	1.000000

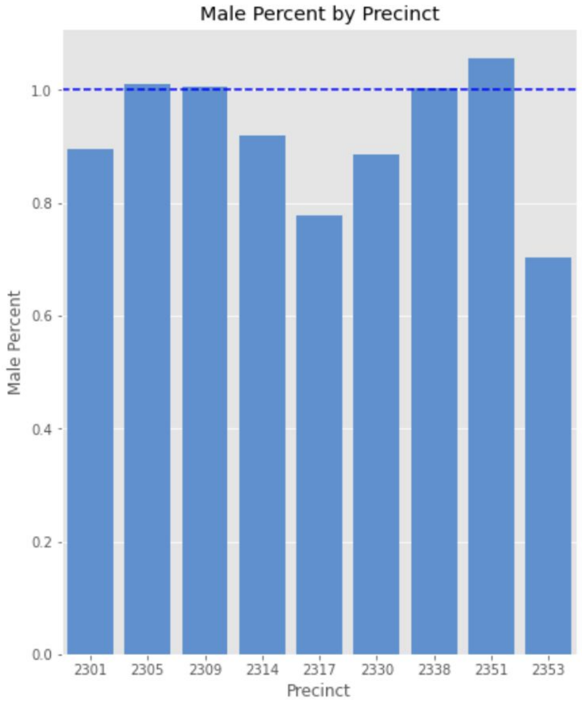
Only use Registered Voters as feature

2.2 Census Data (gender)

- Total Population by Gender, Male Population/Female Population Percent
- Above 18 years Population by Gender, Male 18+ Population/ Female 18+ Population Percent

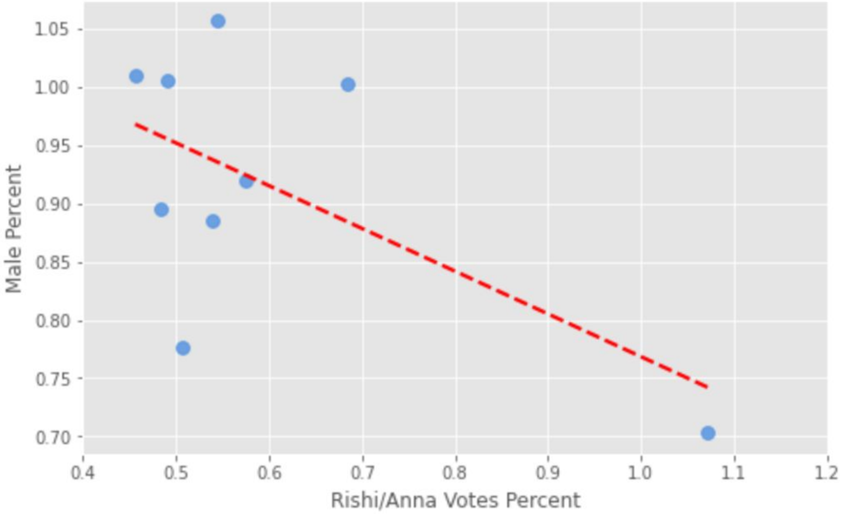
Total Population by Gender

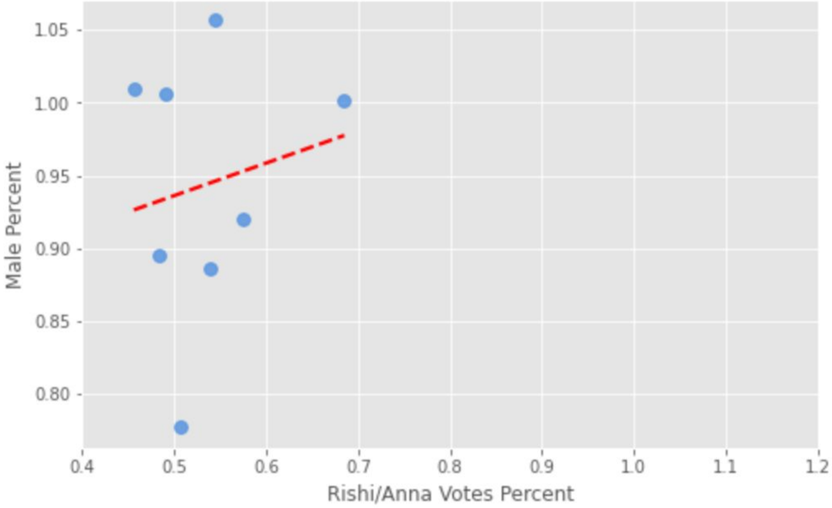




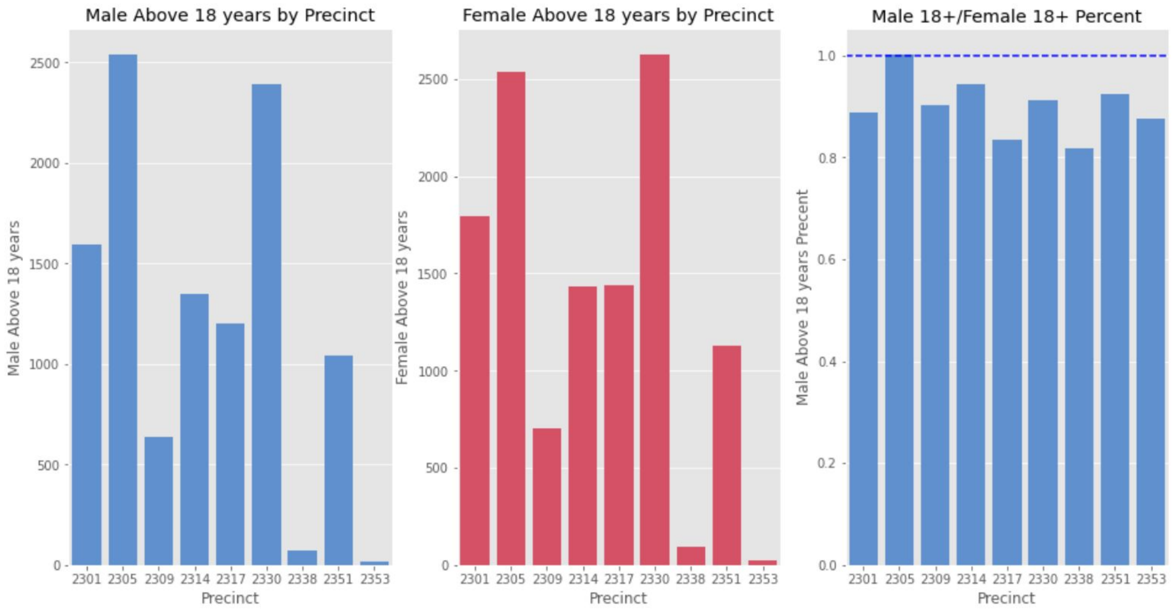
- 2301, 2314, 2317, 2330, 2353 more female
- 2305, 2309, 2338 almost balanced
- 2351 more male

Male Population Percent and Votes Ratio



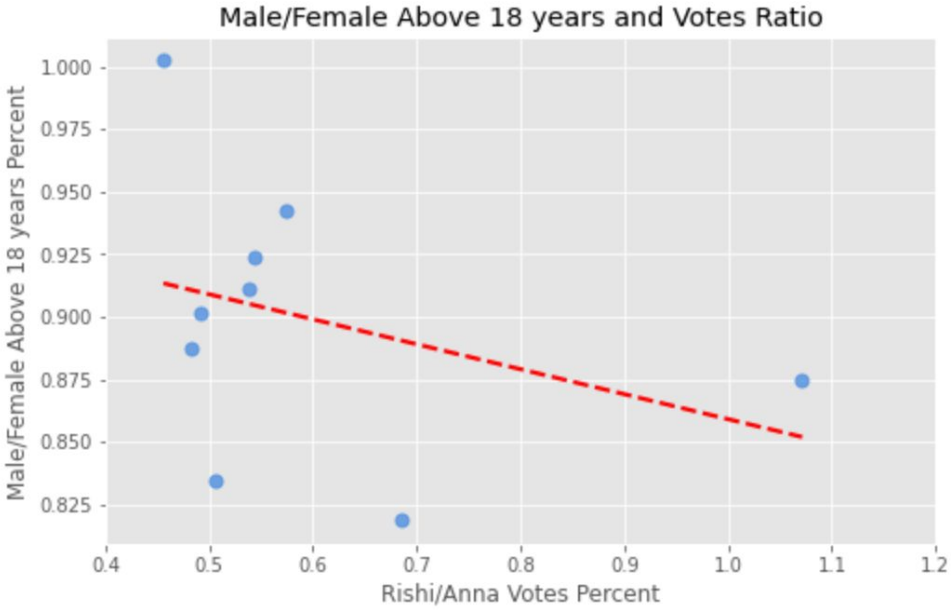


Above 18 years Population by Gender

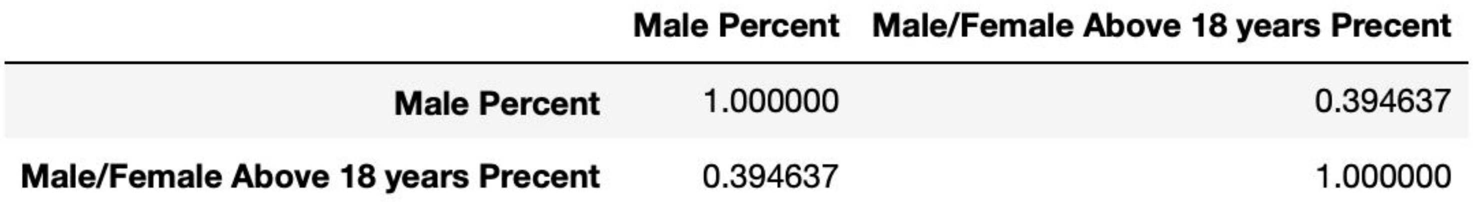


- More female than male except 2305
- 2305 is almost balanced, with percent 1.002

18+ Male/Female Percent and Votes Ratio



Male Percent and Male/Female Above 18 + Percent

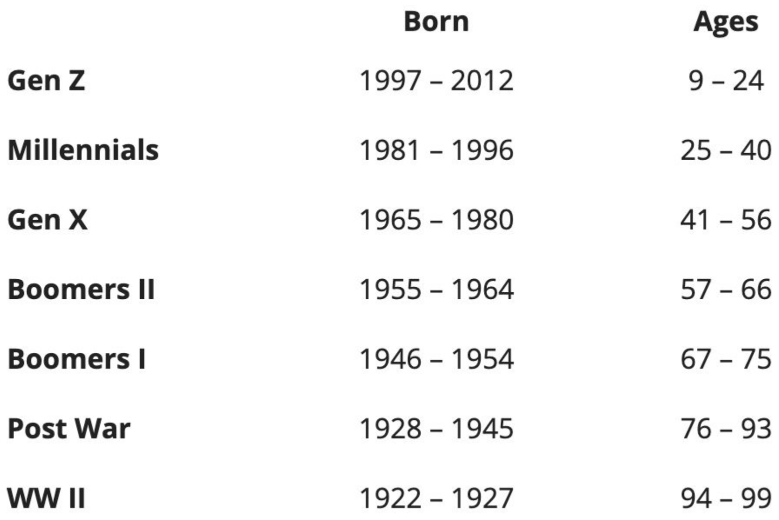


	Male Percent	Male/Female Above 18 years Precent
Male Percent	1.000000	0.394637
Male/Female Above 18 years Precent	0.394637	1.000000

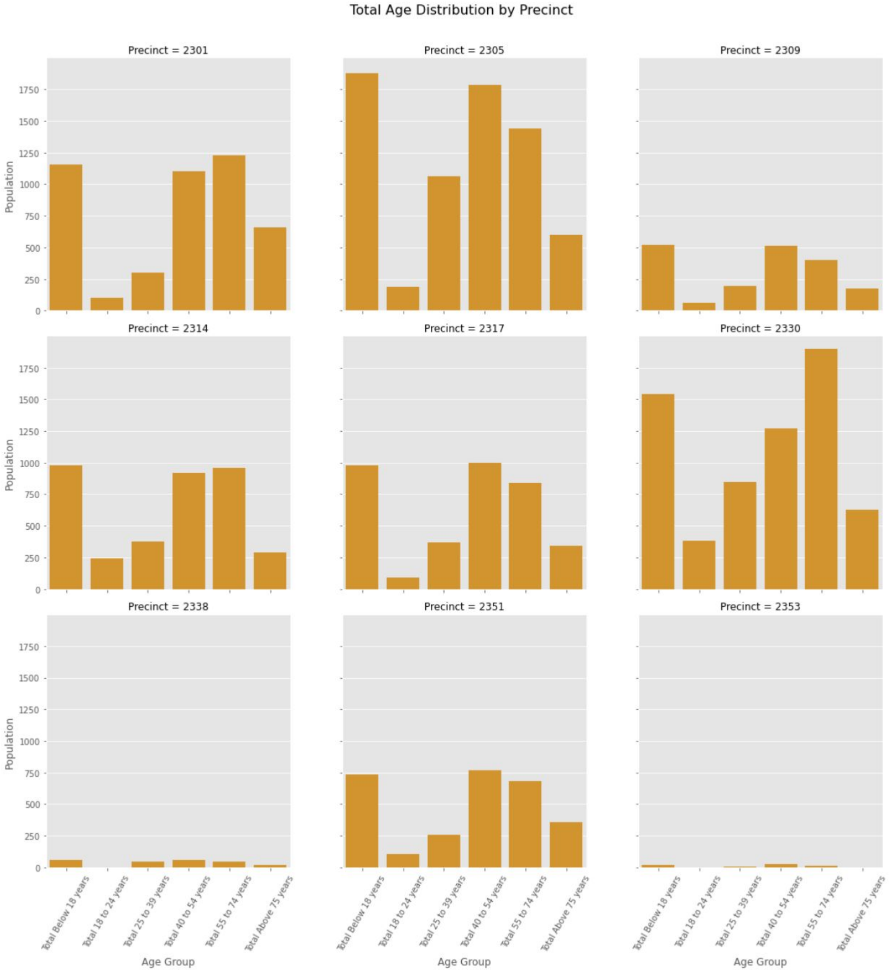
Both will be used as features

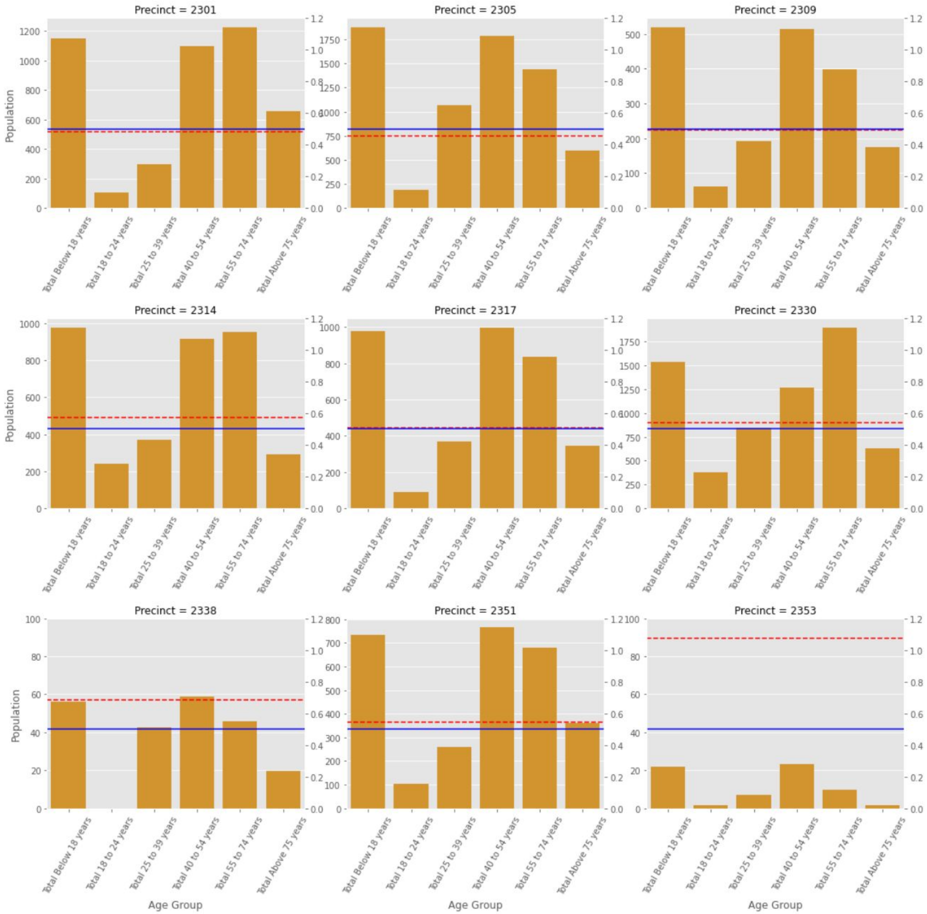
Census Data (Age Distribution)

- Combine original age groups into larger groups
    - Below 18
    - 18 - 24
    - 25 - 39
    - 40 - 54
    - 55 - 74
    - Above 75



	Born	Ages
Gen Z	1997 – 2012	9 – 24
Millennials	1981 – 1996	25 – 40
Gen X	1965 – 1980	41 – 56
Boomers II	1955 – 1964	57 – 66
Boomers I	1946 – 1954	67 – 75
Post War	1928 – 1945	76 – 93
WW II	1922 – 1927	94 – 99


Total Age Distribution by Precinct
Precinct = 2301
Precinct = 2305
Precinct = 2309
Precinct = 2314
Precinct = 2317
Precinct = 2330
Precinct = 2338
Precinct = 2351
Precinct = 2353
Population
0
250
500
750
1000
1250
1500
1750
Total Below 18 years
Total 18 to 24 years
Total 25 to 39 years
Total 40 to 54 years
Total 55 to 74 years
Total Above 75 years
Age Group



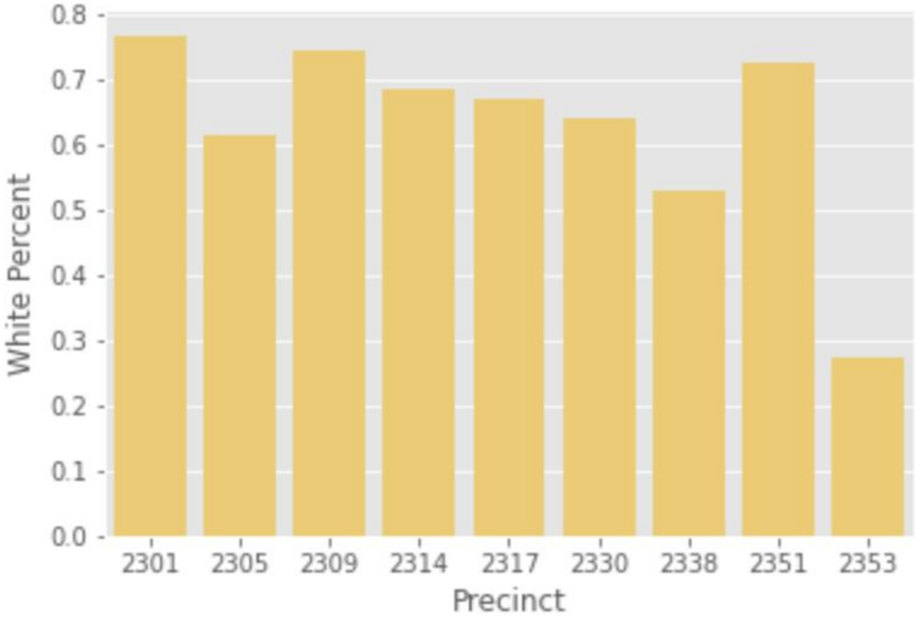
Total Age Distribution by Precinct

Blue Line: 0.5
Red Line: Rishi/Anna Votes Ratio

- (Blue > Red) 2305: young population
- (Red > Blue)2314, 2330, 2351: middle age population to elderly
- (Red >> Blue)2338 and 2353: both have small population

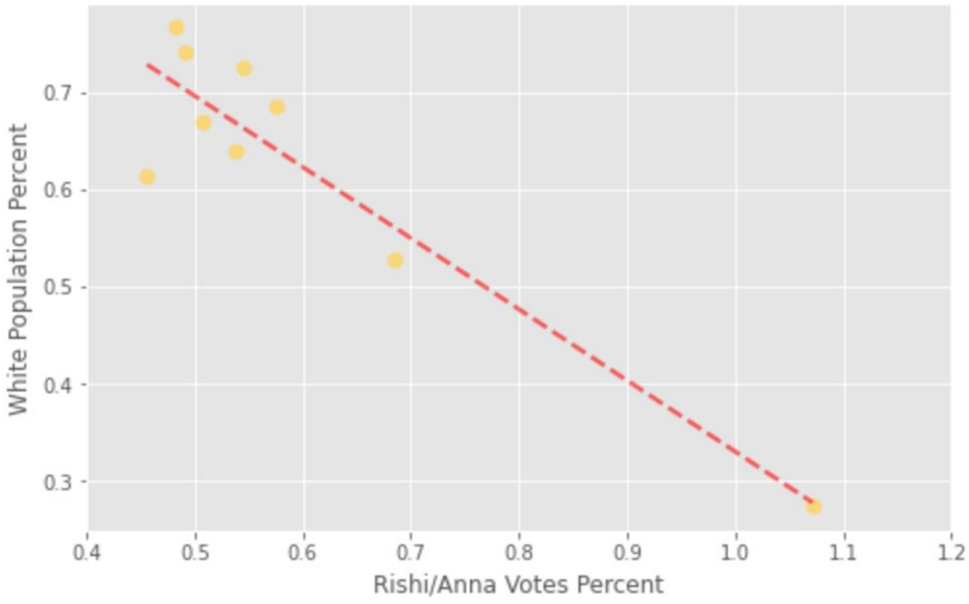
Census Date (Race)

White Population Percent by Precinct



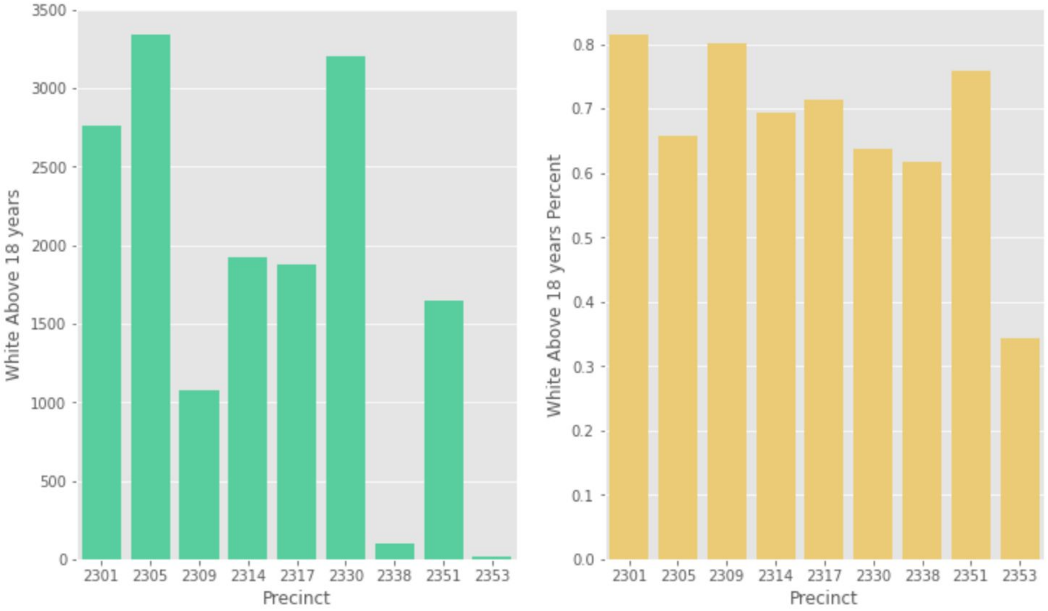
- White population is the majority

White Population Percent and Votes Ratio



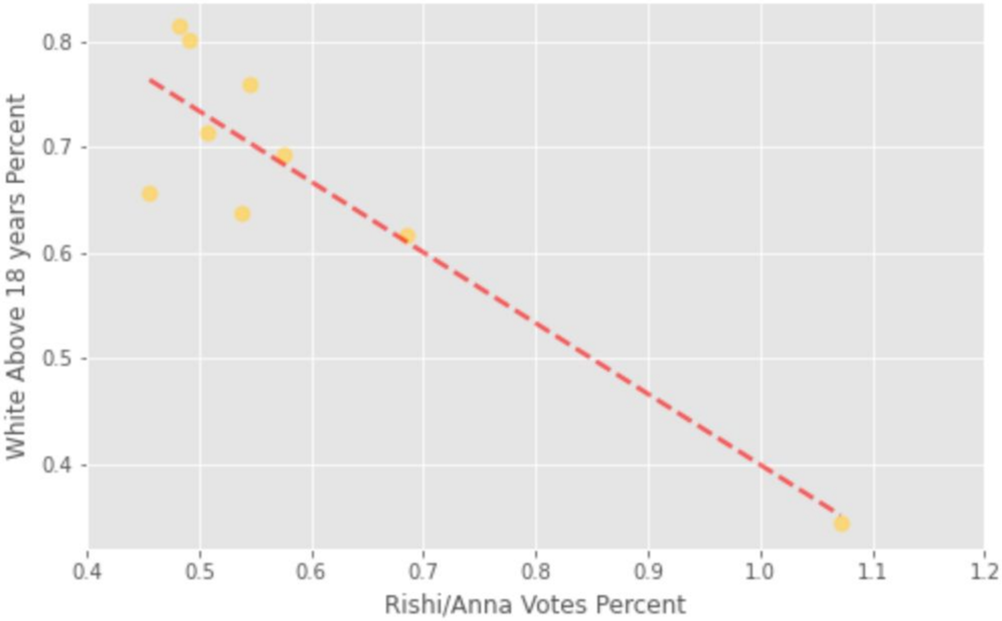
- Clear negative trend

White Above 18 years Population by Precinct



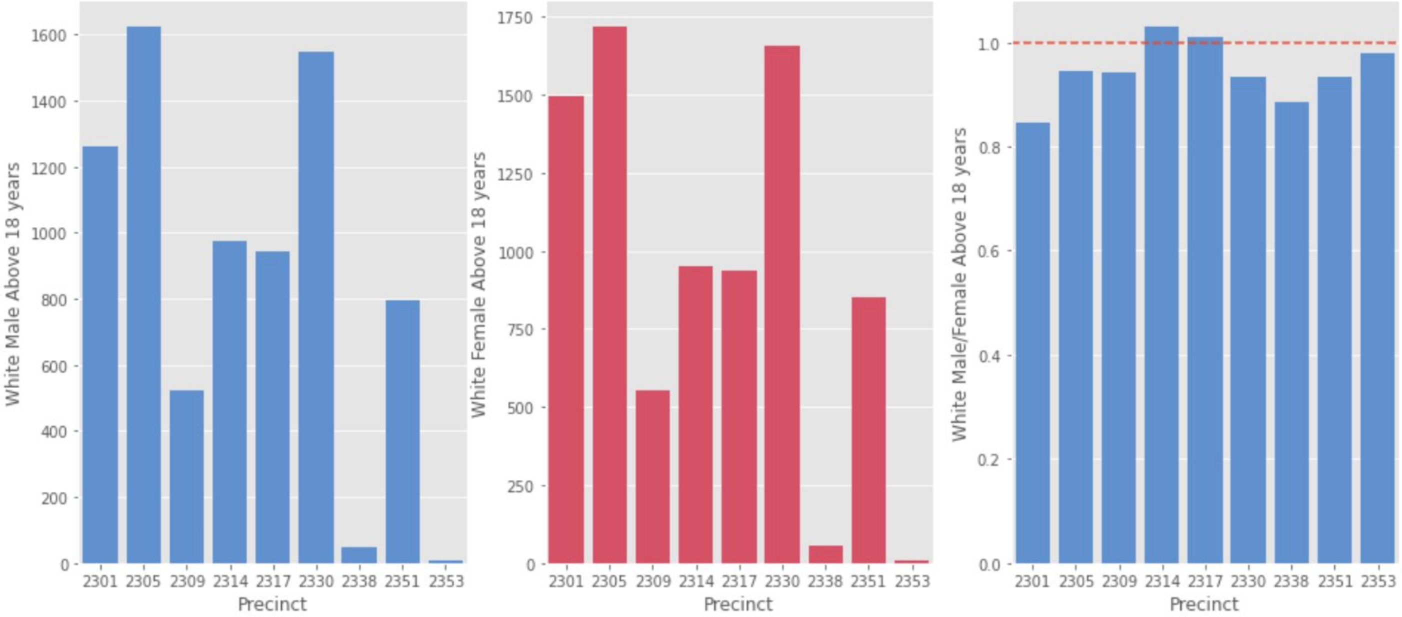
White Above 18 years Percent = White Above 18 years/Total Above 18 years

White Above 18 years and Votes Ratio

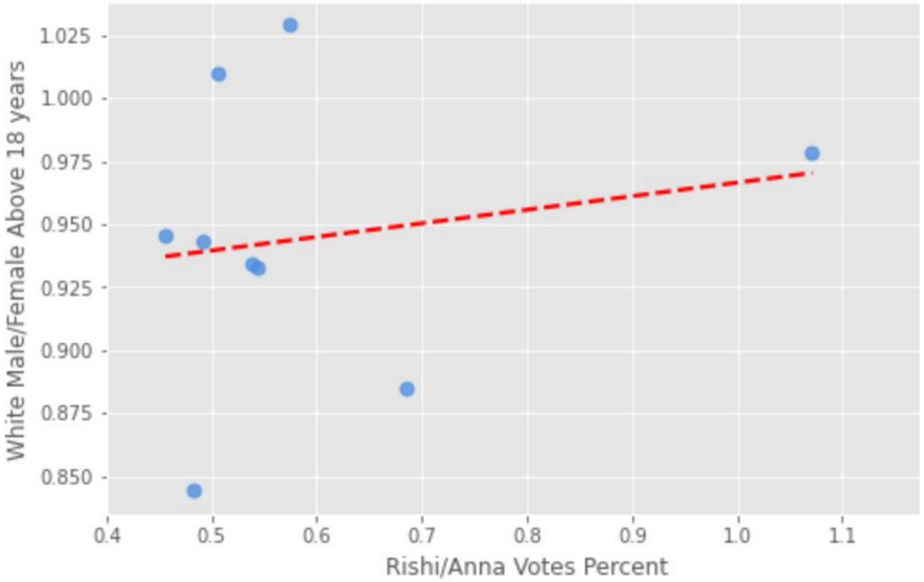


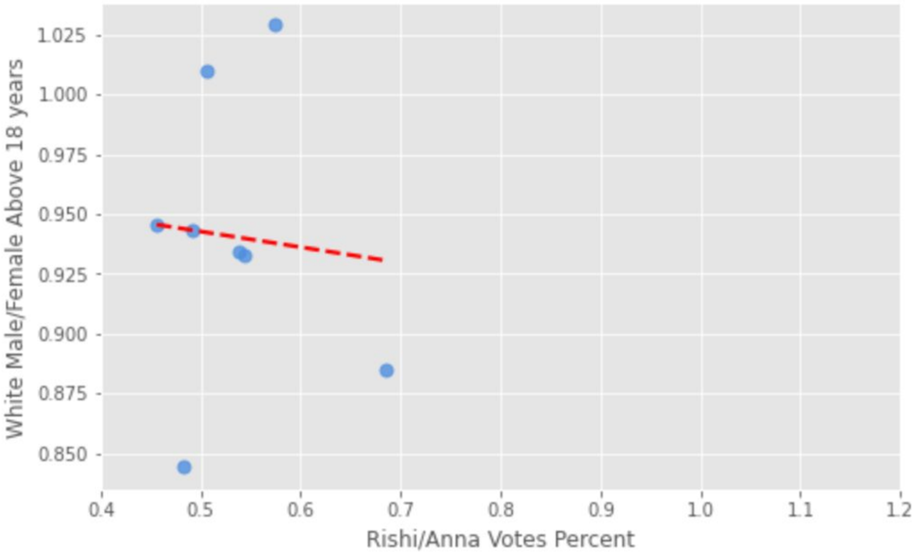
- Clear negative trend

White Above 18 years by Gender (Race & Gender Mixed Factor)



White Male/Female Above 18 years and Votes Ratio





Modeling

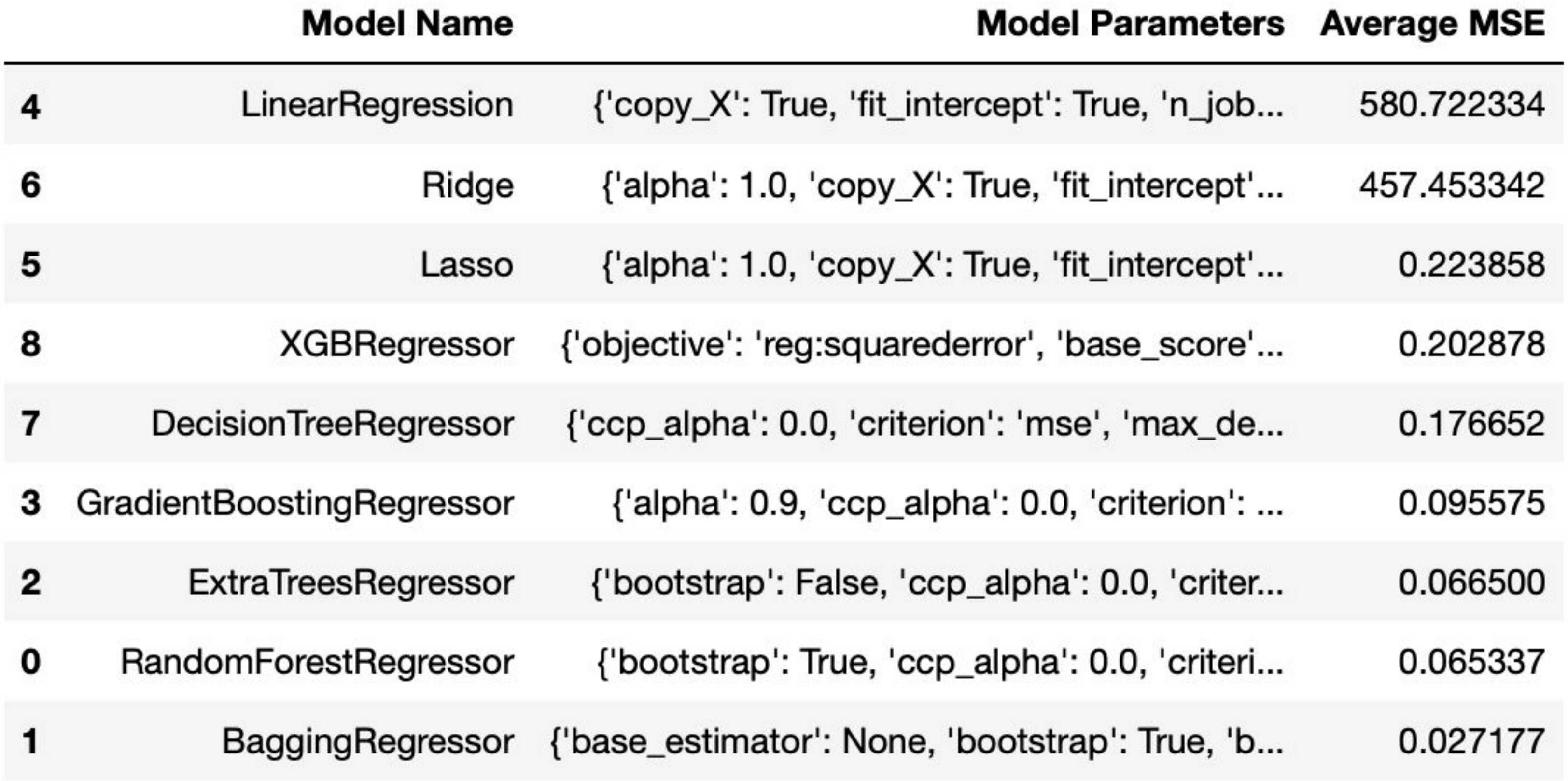
Features:

- Registered Voters
- Male Percent
- Male/Female Above 18 years Percent
- Age Distribution
- White Above 18 years Percent
- White Male/Female Above 18 years Percent

Target: Rishi/Anna Votes Ratio

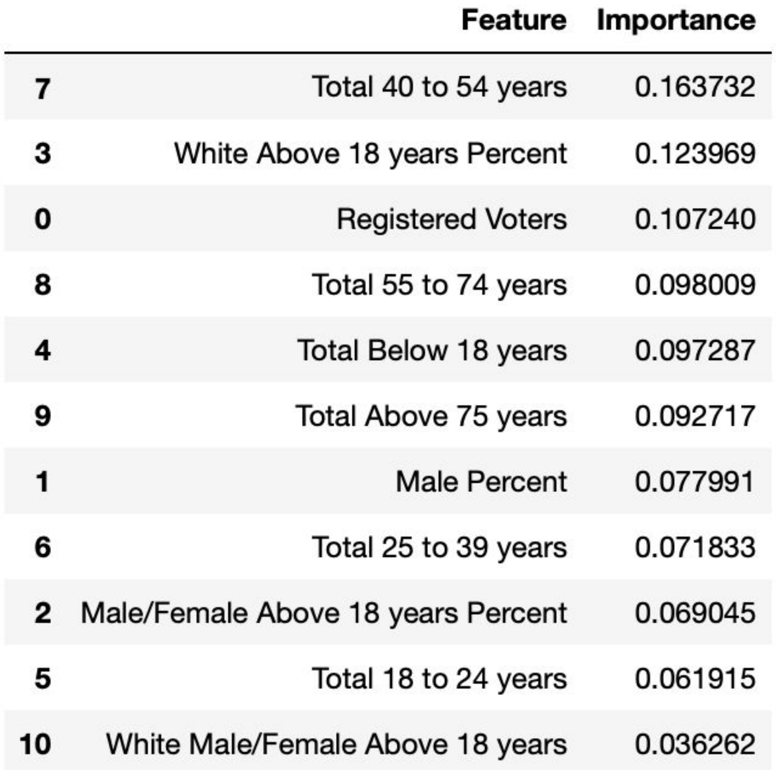
Train/Test: Leave One Out

Metric: MSE



	Model Name	Model Parameters	Average MSE
4	LinearRegression	{'copy_X': True, 'fit_intercept': True, 'n_job...	580.722334
6	Ridge	{'alpha': 1.0, 'copy_X': True, 'fit_intercept'...	457.453342
5	Lasso	{'alpha': 1.0, 'copy_X': True, 'fit_intercept'...	0.223858
8	XGBRegressor	{'objective': 'reg:squarederror', 'base_score'...	0.202878
7	DecisionTreeRegressor	{'ccp_alpha': 0.0, 'criterion': 'mse', 'max_de...	0.176652
3	GradientBoostingRegressor	{'alpha': 0.9, 'ccp_alpha': 0.0, 'criterion': ...	0.095575
2	ExtraTreesRegressor	{'bootstrap': False, 'ccp_alpha': 0.0, 'criter...	0.066500
0	RandomForestRegressor	{'bootstrap': True, 'ccp_alpha': 0.0, 'criteri...	0.065337
1	BaggingRegressor	{'base_estimator': None, 'bootstrap': True, 'b...	0.027177

Feature importances generated by Random Forest Regressor



	Feature	Importance
7	Total 40 to 54 years	0.163732
3	White Above 18 years Percent	0.123969
0	Registered Voters	0.107240
8	Total 55 to 74 years	0.098009
4	Total Below 18 years	0.097287
9	Total Above 75 years	0.092717
1	Male Percent	0.077991
6	Total 25 to 39 years	0.071833
2	Male/Female Above 18 years Percent	0.069045
5	Total 18 to 24 years	0.061915
10	White Male/Female Above 18 years	0.036262

Summary and Future Work

- Anna:
  - Pros: overall significantly more votes(63.2%), represents district 18 since 2013
  - Opportunities: Young Voters, White Voters, Democrats
- Rishi:
  - Cons: overall significantly less votes(36.8%)
  - Opportunities: Middle-Age Voters, Non-White Voters, Non-Democrats
- Future Work:
  - Obtain data of the remaining cities; current dataset is too small so it is hard to find true trend and test the model
  - Better mapping of the block and precinct (e.g. , find a better estimation of registered voters/18+ population), so that the census data is more accurate
  - Gather census data of other topics, such as religions, education, and income

Thank you for listening!