

How Demographics Affect Voter Turnout in Massachusetts

CSCI 1710 Visualization
Final Project

Anitej Thamma
Max Bahar
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Ted McCulloch

Proposal

Title

How do local demographics affect voter turnout in Massachusetts?

Abstract

In any election, it is paramount that all citizens are able to cast their vote and participate in shaping their government. Therefore, resources should be dedicated to maximize voter turnout and increase democratic engagement. To this end, it is important to understand the dynamics behind voter turnout; specifically, how voter turnout is influenced by demographic factors such as race, ethnicity, gender, and income. Unraveling how the elements of one's identity can influence the decision to vote or not vote can help increase the effectiveness of voter turnout programs.

Team Agreement

We, Max Bahar, Stefan Chu, Ted McCulloch, and Anitej Thamma, are putting forward the following agreement about the CS 171 Final Project.

Meetings and Communication

Each member of the team agrees to make time to meet either virtually or in person when needed.

- Meeting Frequency: Meeting frequency will depend on the point in the semester as well as the upcoming deadlines. We anticipate that it should average at least once a week. Group members are expected to conduct most of the project work outside of these meetings.
- Meeting Format: For major decisions (such as design), we agree to meet in person. Otherwise, we can meet virtually via Google Hangouts.
- Communication Channels: Primary communication will be conducted through iMessage. Code collaboration will be conducted through GitHub.

Decision Making

Group agrees to conduct decision making collectively and democratically.

Accountability

Each member of the group agrees to uphold their agreed upon portion of the project as well as active contribution to the success of our project.

Responsibilities

Since Max, Stefan, and Ted are co-conducting the project with AC 209a, their visualizations are expected to be more involved with advanced applications of the data. This will be considered when agreeing about the allocation of different visual designs.

Shared Responsibilities

1. Initial EDA/familiarity with dataset
2. Contribute to the design of visualizations
3. Complete the implementation of their allocated visualizations
4. Meet all submission deadlines for project

Typed Signatures Below

Theodore McCulloch

Maximilian Bahar

Stefan Chu

Anitej Thamma

Project Plan

Basic Info

Title: How do local demographics affect voter turnout in Massachusetts?

Group Members:

- Anitej Thamma (anitej_thamma@g.harvard.edu)
- Max Bahar (maxbahar@g.harvard.edu)
- Stefan Chu (stefanchu@g.harvard.edu)
- Ted McCulloch (tmcculloch@g.harvard.edu)

Background and Motivation

Research conducted by [Pew Research Center](#) has shown that the demographics of voters and nonvoters are vastly different at the national level. On average, voters were more likely than nonvoters to be older, identify as White, and have a college degree. We believe that everyone should have the ability to cast their vote and participate in shaping their government. Furthermore, low voter turnout may exclude citizens with certain political views, skewing the results of the elections. Therefore, it is important to understand the dynamics between voter turnout and demographics, particularly at the local level, so efforts to increase voter turnout can be tailored to each area.

Related Work

There are lots of great data visualization examples surrounding US elections:

- Many focus on the winning party in a specific area, such as this map from [the Washington Post](#).
- [The Census Bureau](#) has an entire library of plots dedicated to understanding voter turnout over time and by demographics at the national level.

We hope that our project can contribute to existing work by providing an analysis and visualization of voter turnout and demographics at a smaller scale.

Data

We will be utilizing data from [RedistrictingDataHub.org](#), specifically:

- CSV file for 2022 Massachusetts Voter File Elections Turnout Statistics at the 2020 Census Blocks level.
- Shapefile for Massachusetts block PL 94-171 2020 (Census Blocks).

Access to the data requires signing up for a free account.

Data Cleanup

We expect to have to do a good amount of data cleanup. While election data and demographic data have already been attached to 2020 Census Block IDs, these IDs will need to be matched with those from the Shapefile. Variables in the dataset may also need to be encoded in the right format to work with our choice of model. Furthermore, since this is a joint project with AC209A (Introduction to Data Science), additional data cleaning may be needed to incorporate supplementary demographic data for a more thorough analysis.

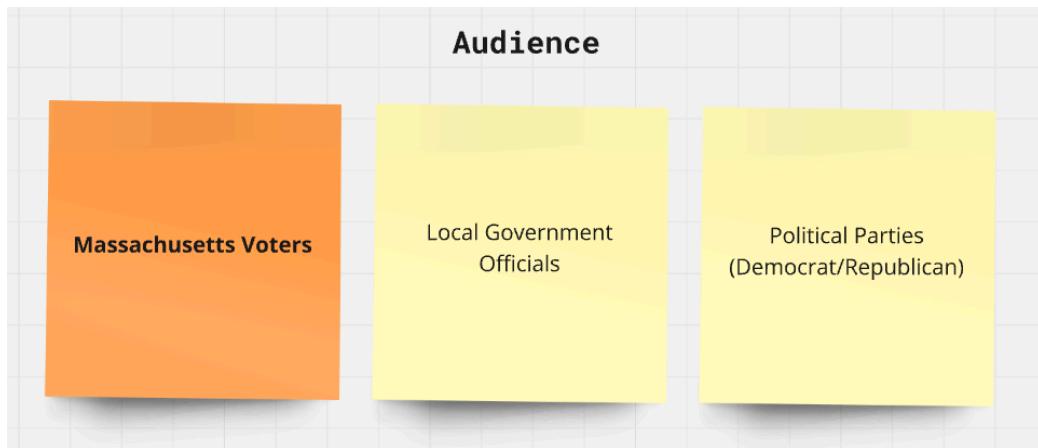
We hope to use the racial/ethnicity demographic information and voter turnout rates from the Census Survey that are both present in the Voter Turnout CSV file.

Data processing will be conducted via OpenRefine and Python scripts.

Project Map

Team

1. Who is your audience? Come up with at least three options and pick one target audience.



Three potential audiences for our visualization project are:

- Massachusetts Voters
- Local Government Officials
- Political Parties

For our final project, we will focus on Massachusetts voters, creating a data story that informs people about voter turnout for the state they live in.

2. Describe your target audience in more detail. What do they know? What are their interests? What visualization literacy do they have? At what level of detail will you present information to them?

Voters in Massachusetts will know the area that they live in, but may not be so familiar with other parts of the state. Similarly, they may be very interested in their immediate vicinity or neighborhood but less so in parts of the state that are very far away. In terms of visual literacy, they will likely be able to comprehend visualizations that are on the simpler side. We hope to present information at the level of Census Blocks, which are smaller than 5-digit ZIP codes. However, we will also aggregate this information to Census Block Groups, Tracts, or Counties for simpler visualizations at the state level.

3. *What questions about your data will be interesting for your audience? Come up with a list of interesting questions that your audience may have about your data. The more, the better, but your team should come up with at least ten questions.*

Questions		
How does demographics affect voter turnout in Massachusetts?	What is voter turnout in my neighborhood like?	How does voter turnout vary in Western, Central, and Eastern Massachusetts?
How does voter turnout vary in different counties?	How does the size of Metropolitan Statistical Area (MSA) (or size of the city) affect voter turnout?	How does party affiliation affect voter turnout in Massachusetts?
Is voter turnout by demographic group representative of the actual population?	How does voter turnout vary for different elections?	Did young voter's behavior vary in the 2020 election compared to other elections?
	How is voter turnout correlated with distance to the nearest polling location?	

Some interesting questions our audience might have about our data:

1. How does demographics affect voter turnout in Massachusetts?
 2. What is voter turnout in my neighborhood like?
 3. How does voter turnout vary in Western, Central, and Eastern Massachusetts?
 4. How does voter turnout vary in different counties?
 5. How does the size of Metropolitan Statistical Area (MSA) (or size of the city) affect voter turnout?
 6. How does party affiliation affect voter turnout in Massachusetts?
 7. Is voter turnout by demographic group representative of the actual population?
 8. How does voter turnout vary for different elections?
 9. Did young voter's behavior vary in the 2020 election compared to other elections?
 10. How is voter turnout correlated with distance to the nearest polling location?
-
4. *What data do you have? Download the data you picked from the website linked in the PDF that describes the data (available on Canvas, week 2). Look at it in Excel or Google spreadsheet and briefly describe each attribute and its data type (categorical, ordinal, or quantitative) in your process book. It's OK if you are unsure about the data type for some attributes - you can simply describe them (e.g., geographic location).*

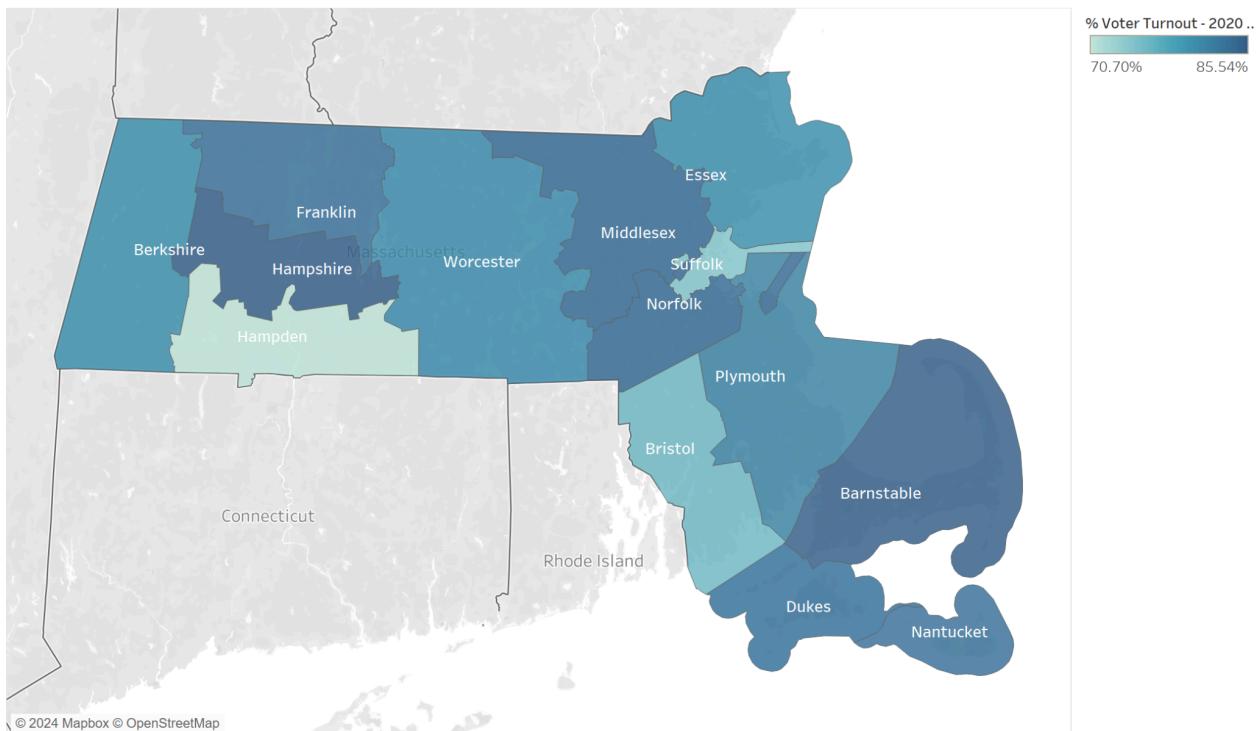
We've conducted some exploratory data analysis in AC209A, most of our data are quantitative variables as they are counts of people at the Census Block level. A descriptive table of our variables can be found below:

range	name	type	description
0	geoid20	15 char string	15-character GEOFID corresponding to 2020 Census Blocks, based on L2 geo-referencing of individual voter addresses
1	total_reg	int	Count of total registered voters in the County, as geo-referenced by RDH from L2 voter file dated above
2-11	age_*_*	int	count of people in age range in that census block
12-14	voters_gender_*	int	gender count
15-24	party_*	int	count of voters registered in party
25-30	eth1_*	int	count of members in broad ethnic category
31-56	eth2_*	int	count of those in narrow ethnic category
57-62	languages_description_*	int	count fluent in language
63	commercialdata_estimatedhhincomeamount_avg	num	Average of modeled data for estimated household income reported by L2 for individuals in the following ranges: \$1,000-\$14,999/ \$15,000-\$24,999/ \$25,000-\$49,999/ \$50,000-\$74,999/ \$75,000-\$99,999/ \$100,000-\$124,999/ \$125,000-\$149,999/ \$150,000-\$174,999/ \$175,000-\$199,999/ \$200,000-\$249,999/ \$250,000+
SKIP	g20221108_*	num	not covering this election
SKIP	p20220906_*	num	not covering this election
SKIP	s20211214_*	num	not covering this election
SKIP	s20211130_*	num	not covering this election
SKIP	s20211102_*	num	not covering this election
SKIP	s20210330_*	num	not covering this election
SKIP	s20210302_*	num	not covering this election
*	g20201103_*	num	2020 general election
SKIP	p20200901_*	num	not covering this election
SKIP	s20200602_*	num	not covering this election
SKIP	pp20200303_*	num	not covering this election - 2020 presidential primary

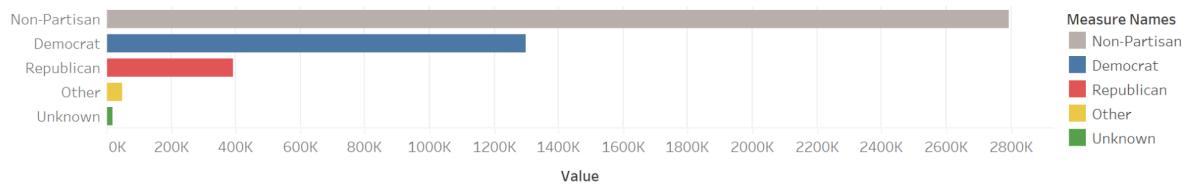
Individual

Max Bahar

Voter Turnout for the 2020 Presidential Election by County

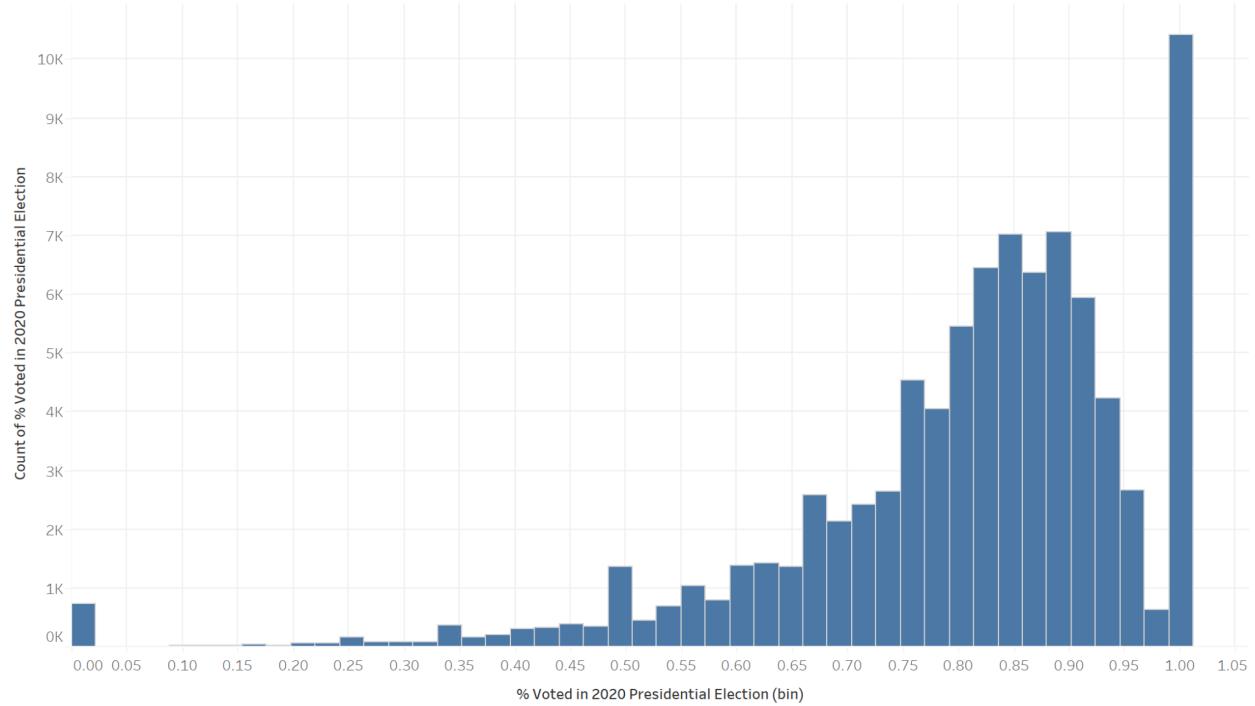


Distribution of Voters by Party Affiliation



Non-Partisan, Democrat, Republican, Other and Unknown. Color shows details about Non-Partisan, Democrat, Republican, Other and Unknown.

Distribution of Voter Turnout in Census Blocks in the 2020 Presidential Election



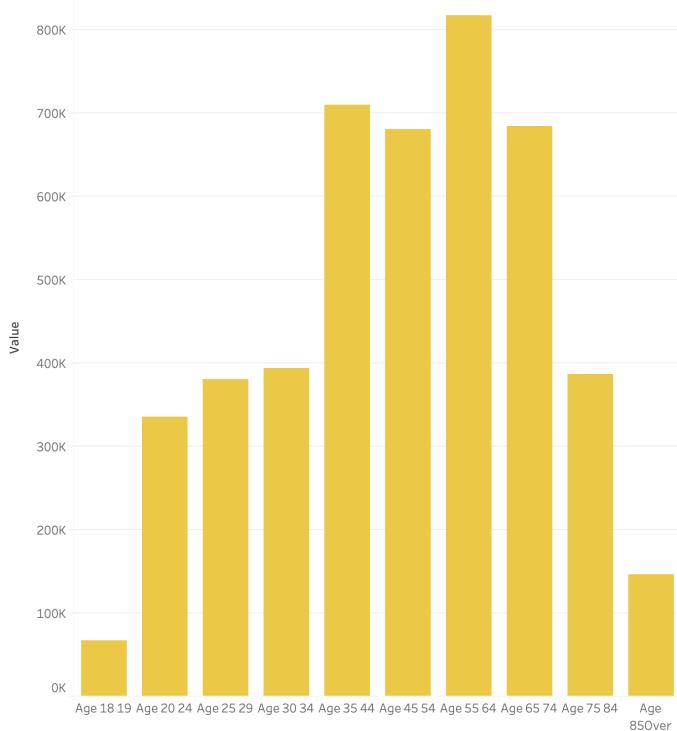
The trend of count of % Voted in 2020 Presidential Election for % Voted in 2020 Presidential Election (bin).

The first visualization shows voter turnout for the 2020 presidential election by county, answering the question "How does voter turnout vary by county?" The second visualization shows the party affiliation of voters in Massachusetts, answering the question "What is the distribution of party affiliation in Massachusetts voters?" The final visualization shows the distribution of voter turnout in the 2020 presidential election by Census Blocks, answering the question "What is the typical voter turnout for Massachusetts Census Blocks?" I think that the map is the best among all the visualizations, as it provides valuable context for the viewer, allowing them to see how voter turnout is where they live. Some of our original questions like "How does party affiliation affect voter turnout in Massachusetts?" require some additional work to establish causality, and is outside the scope of how we've been utilizing Tableau so far.

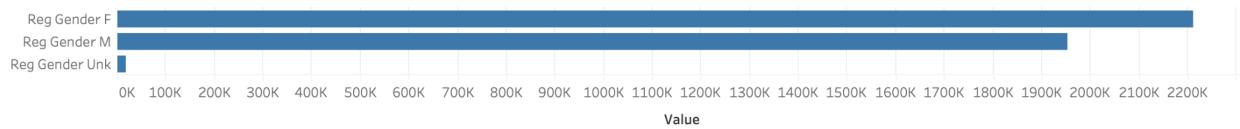
Anitej Thamma

Theodore McCulloch

Distribution of Voters by Age



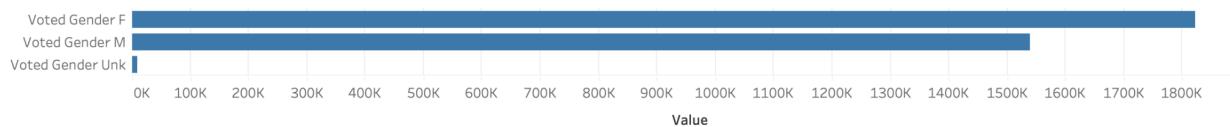
Registration on or before 2020 General Election



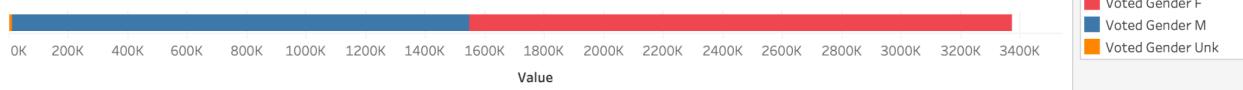
Registration on or before 2020 General Election



Votes by Gender 2020 General Election



Votes by Gender 2020 General Election

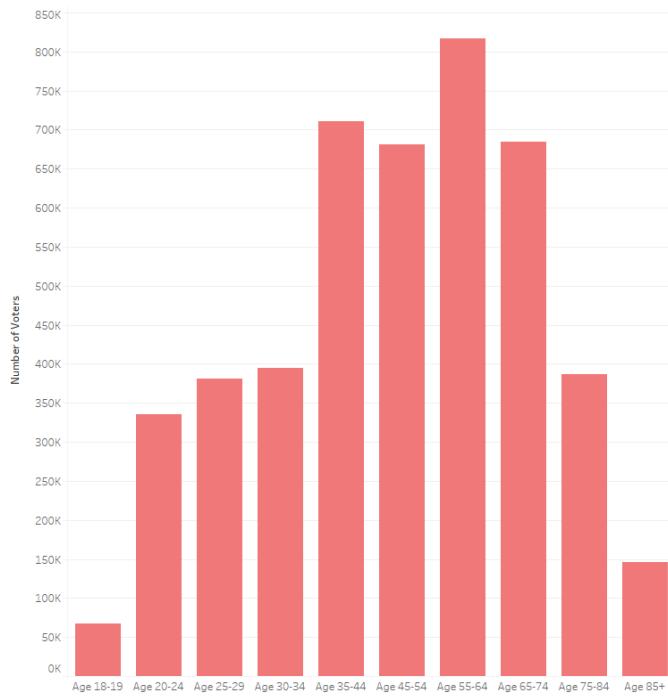


My first question was what does the voting population look like by age? This is addressed by the histogram. My next question: what was both the voter turnout and registered population separated by gender? I have four graphs for this; two of the graphs are different displays of the same information. Many of our questions will involve some form of regression or model fit,

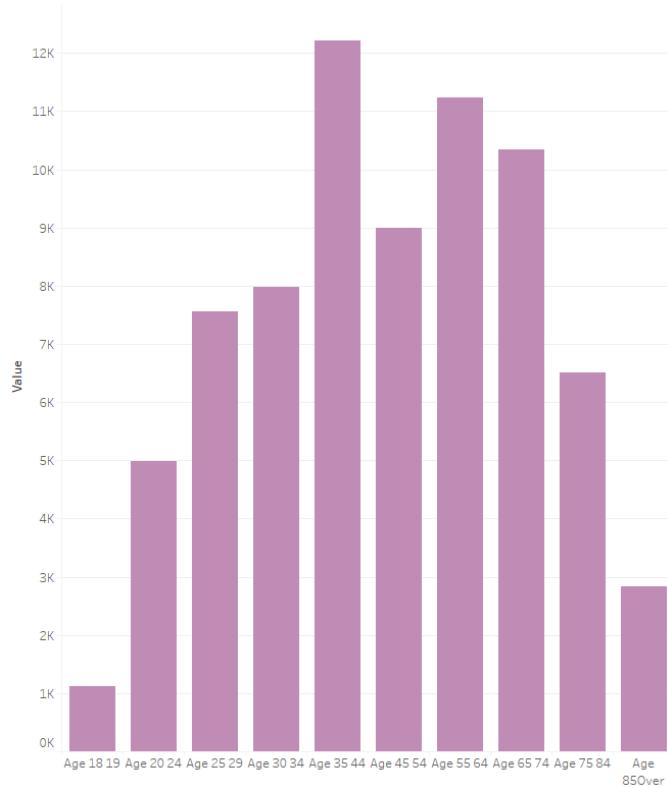
which is outside of how I've used Tableau up until now. That's why I focused on more narrower questions that involved count comparisons of different categories. You can glean a lot by looking at the shape of data, but determining relationships or causality requires more statistical footwork.

Stefan Chu

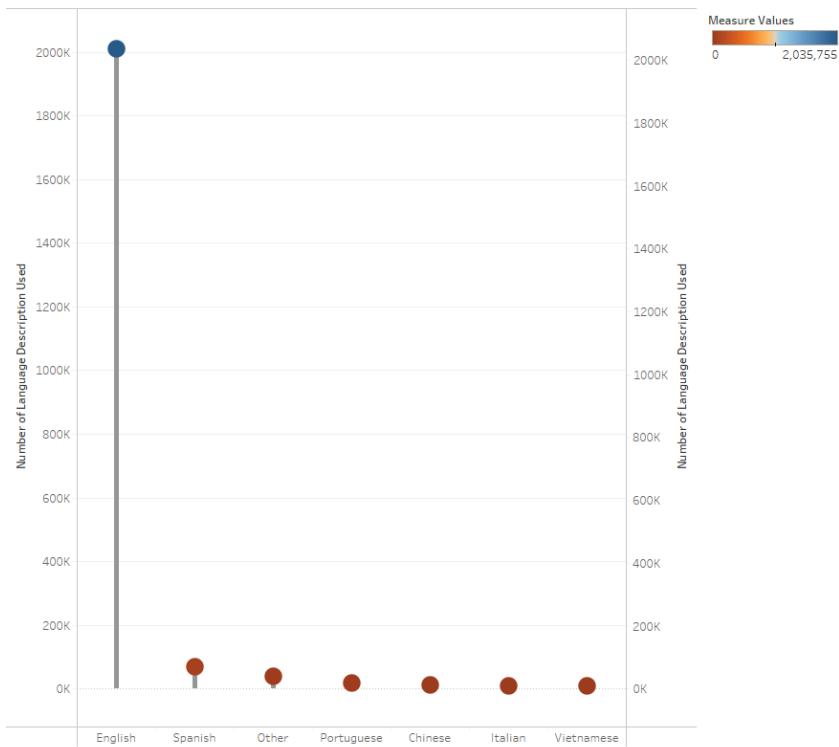
Voter Histogram by Age Brackets



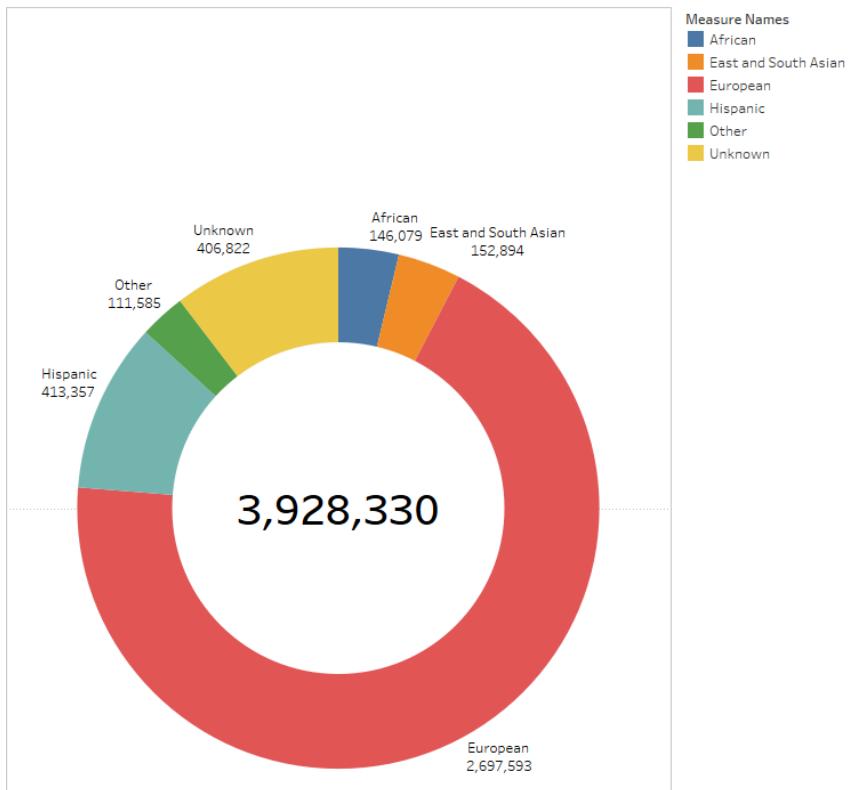
Dropped Voter Histogram by Age Brackets



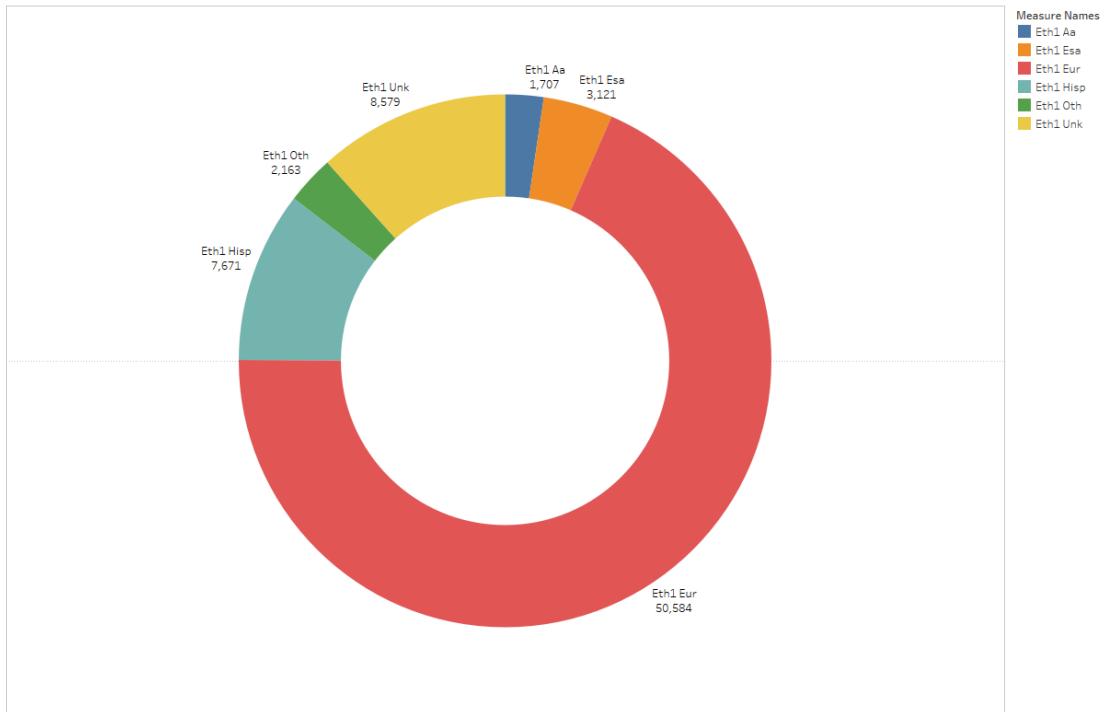
Language Description Lolipop Chart



Voter Count by Ethnicity Donut Chart



Dropper Voter Count by Ethnicity Donut Chart



Total: 73825

I looked at the distribution of voters by age. It is interesting that the Census blocks do not bracket the ages by the same span of years. It could be worth looking into. We are interested as a group in seeing whether many young voters are coming out to vote. Personally, I was interested in not only how demographic features such as ethnicity affect voter turnout, but also the availability of language resources. Many bilingual voters vote in English, but there are many citizens who prefer to vote in a language other than English, with Spanish being the 2nd most prominent language in the United States. The lollipop chart shows the vast difference that may not reflect the actual proportion of the population. Finally, the donut chart at the end shows the proportion of Massachusetts voters by ethnicity. One of our groups questions is whether this is reflective of the true proportions of each ethnicity within each county.

Data, Sketches, Decide & Storyboard

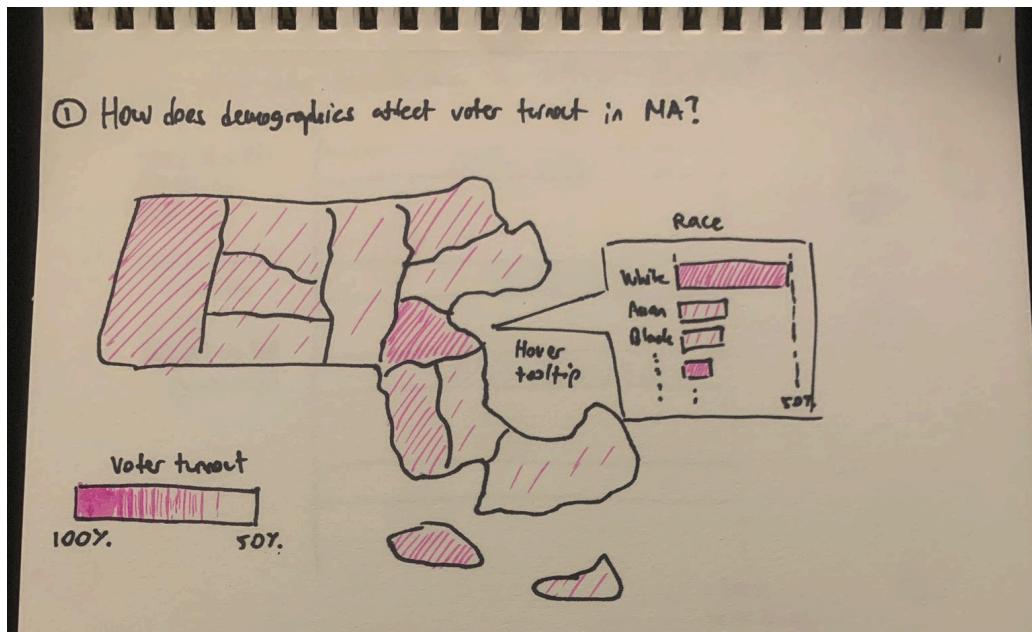
Sketches

Questions

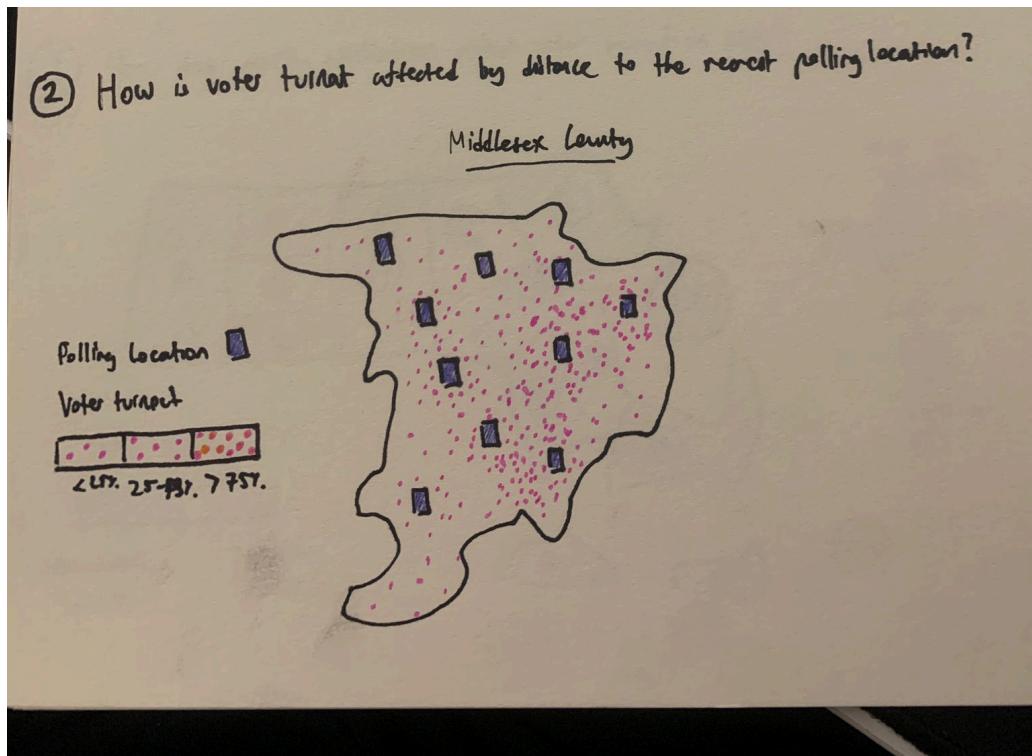
1. How does demographics affect voter turnout in Massachusetts?
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10. How is voter turnout correlated with distance to the nearest polling location?

Max

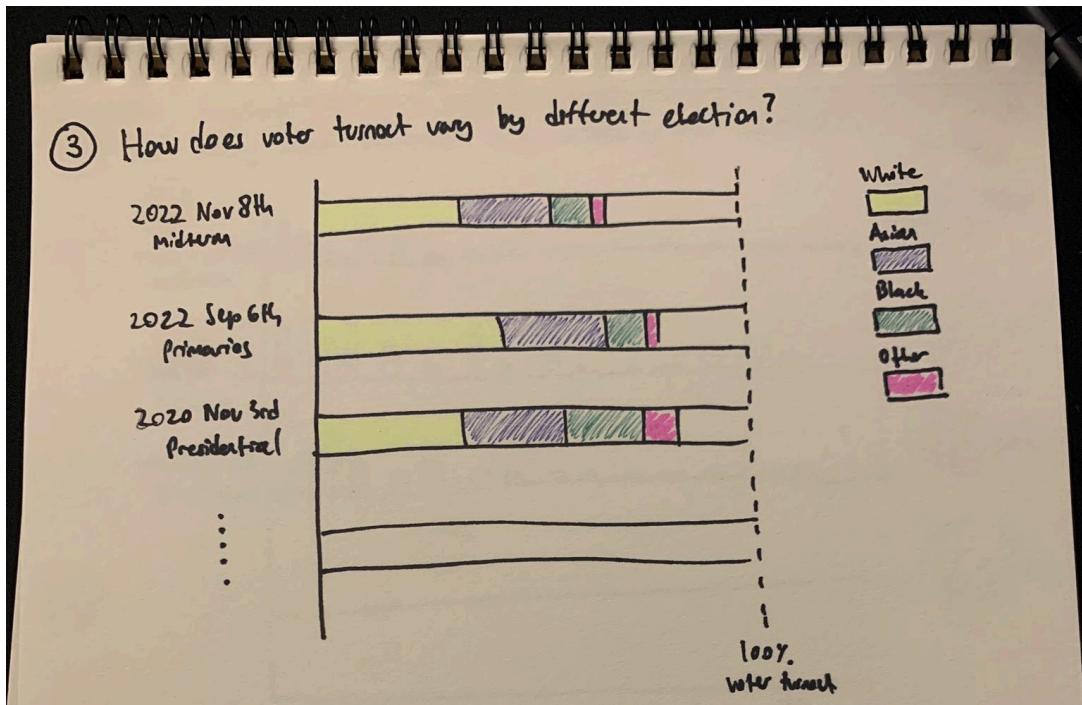
Sketch 1: Questions 1, 3, 4



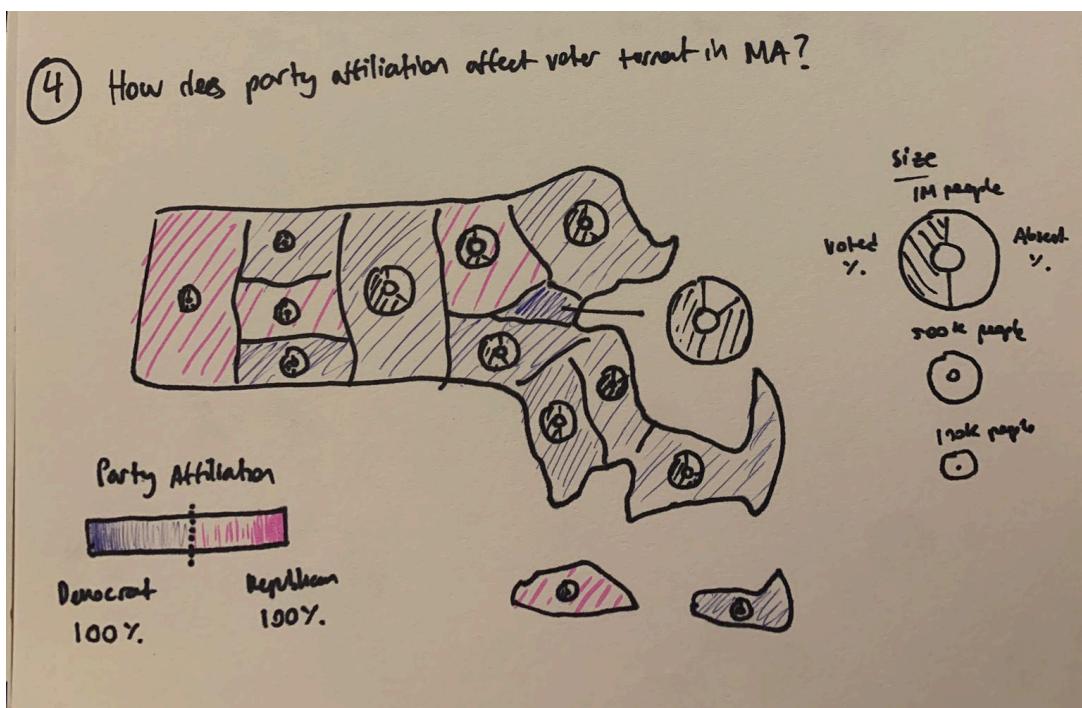
Sketch 2: Questions 2, 10



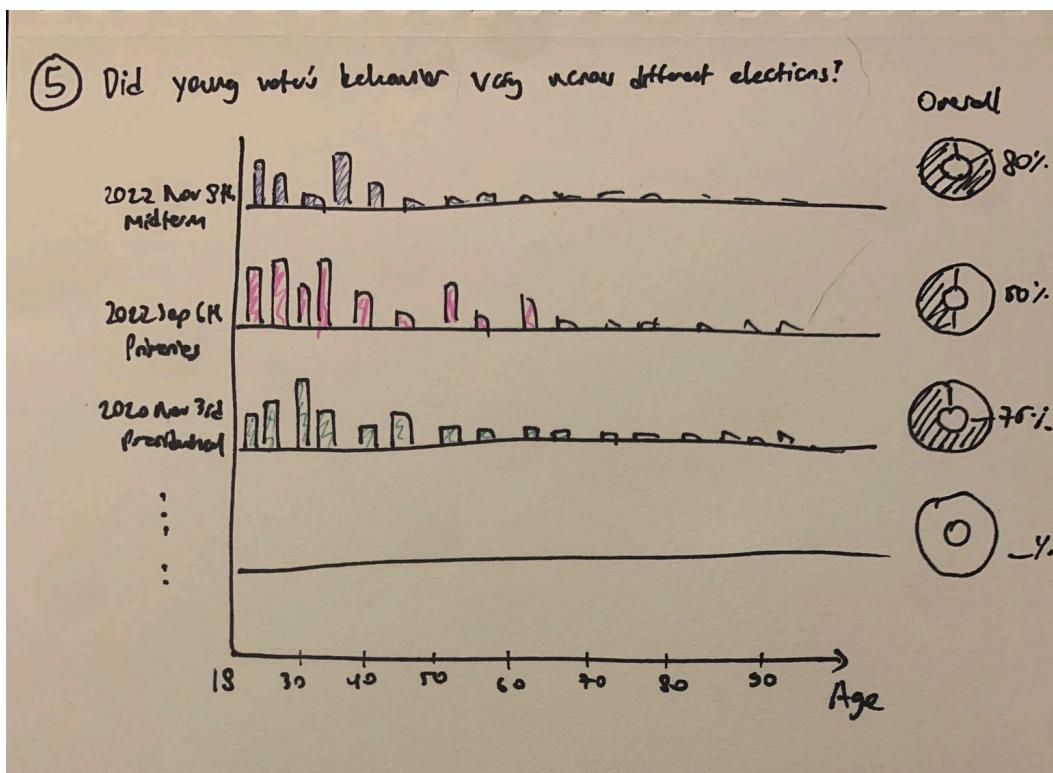
Sketch 3: Questions 1, 7



Sketch 4: Questions 3,4,6

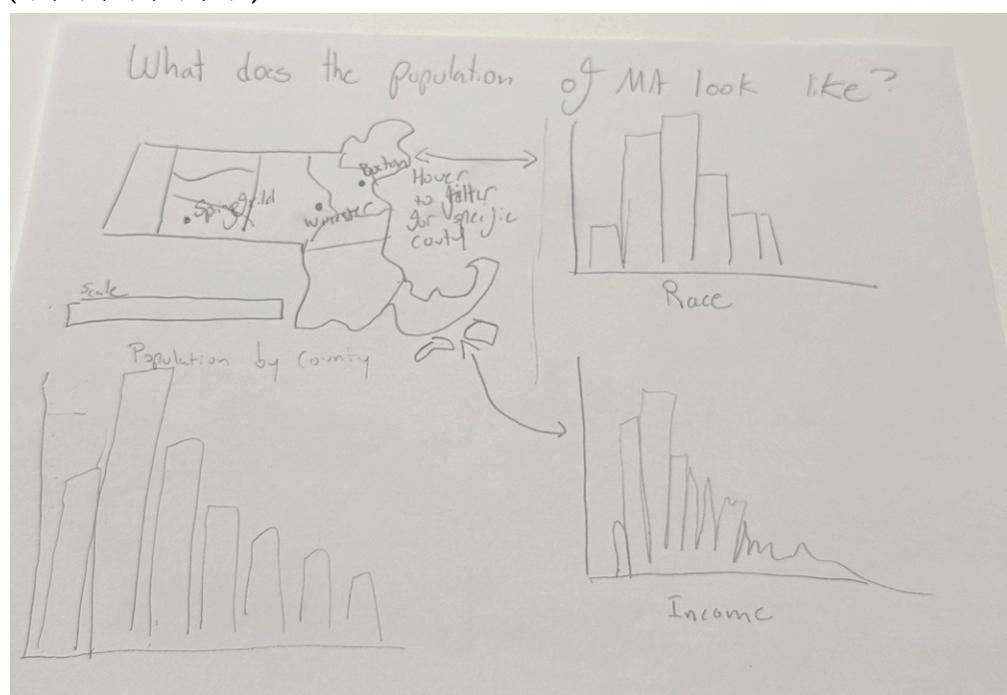


Sketch 5: Questions 1, 8, 9

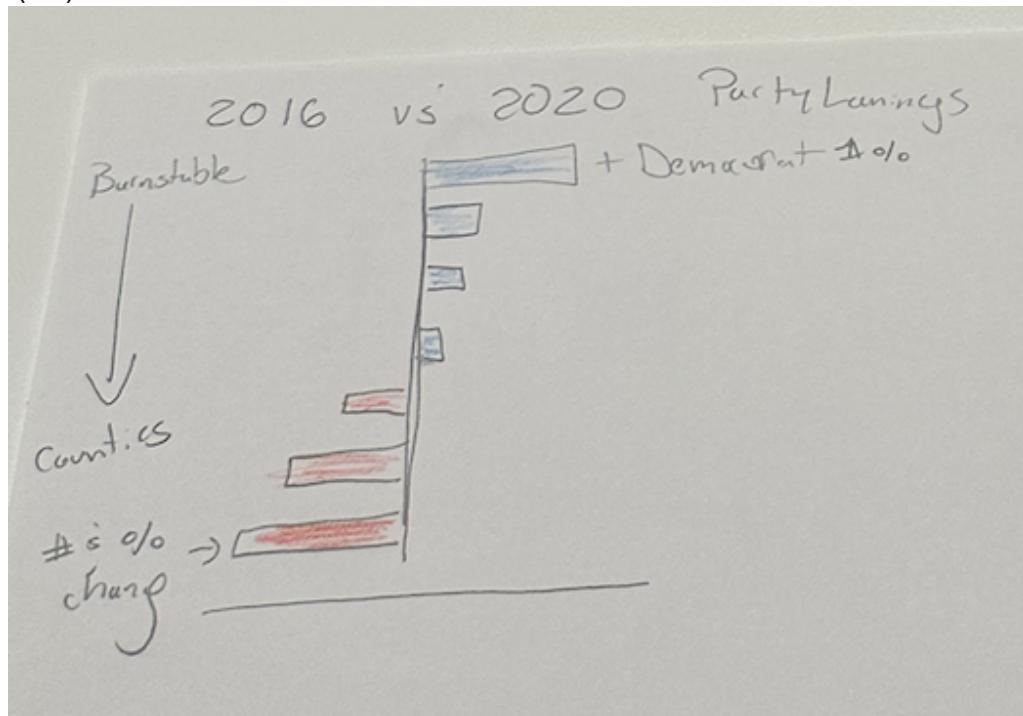


Ted (Sketches 6-10)

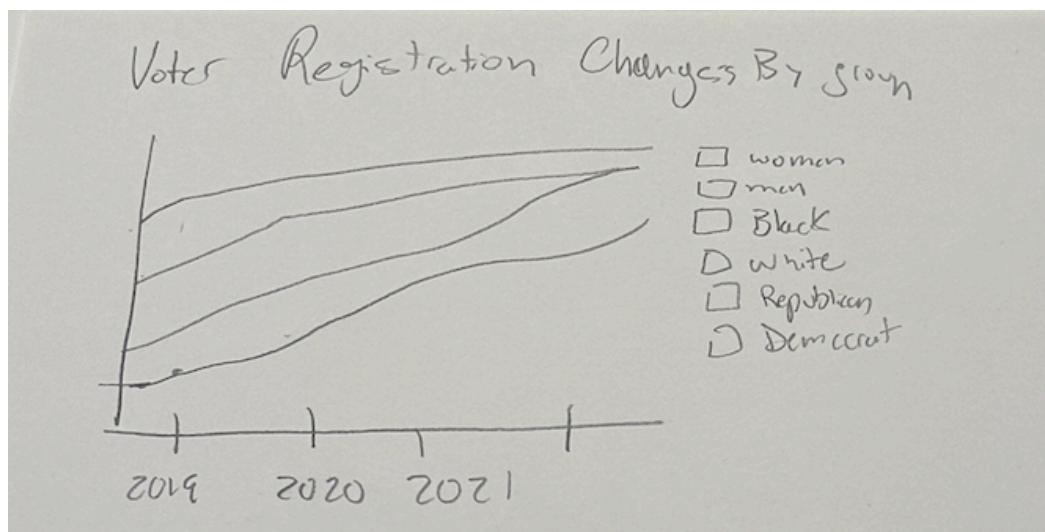
Sketch 6 (Q1, Q2, Q3, Q4, Q5)



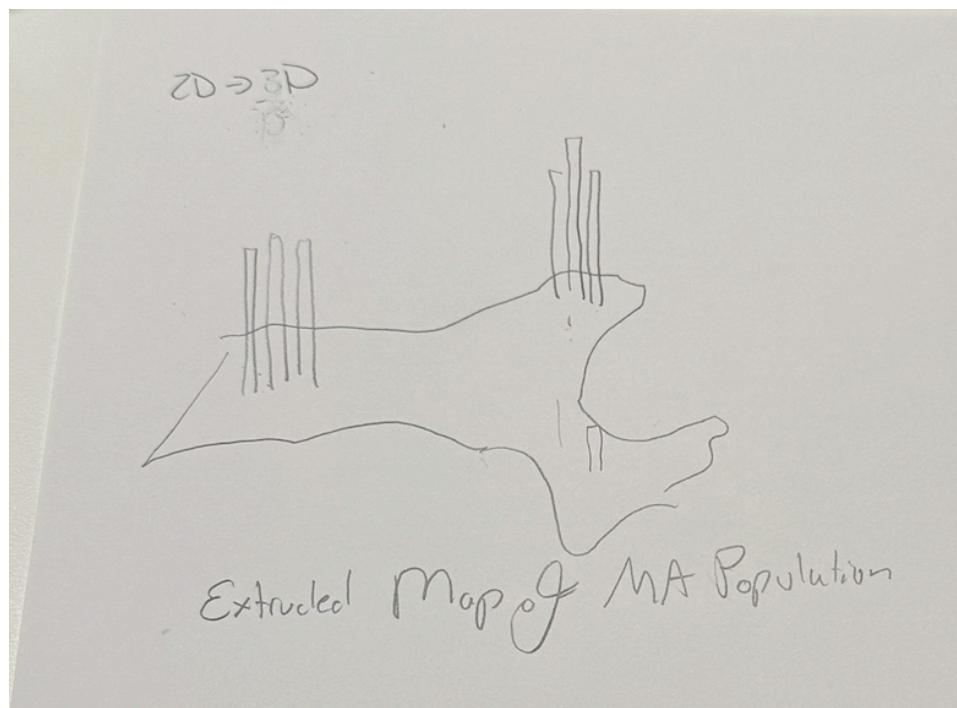
Sketch 7 (Q8)



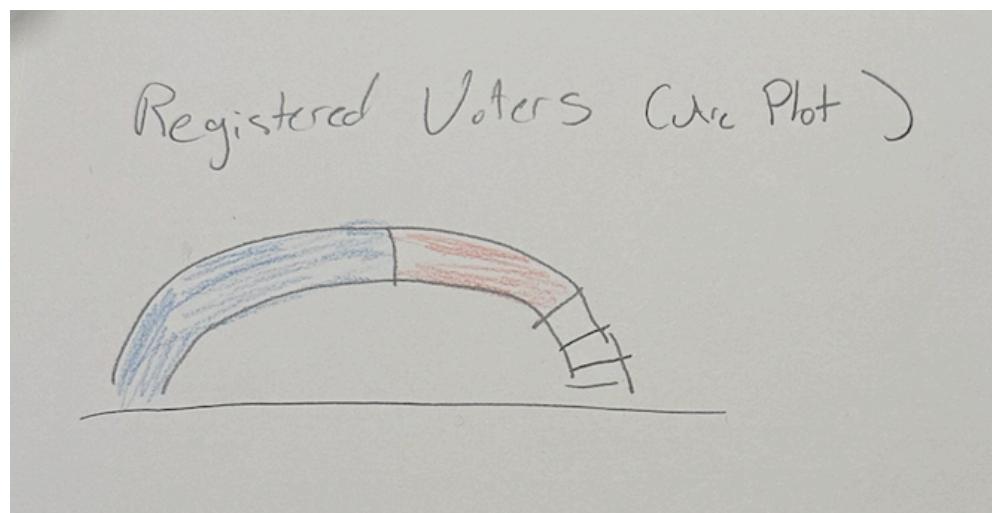
Sketch 8 (Q1, Q2, Q8, Q9)



Sketch 9 (Q1, Q2, Q5)

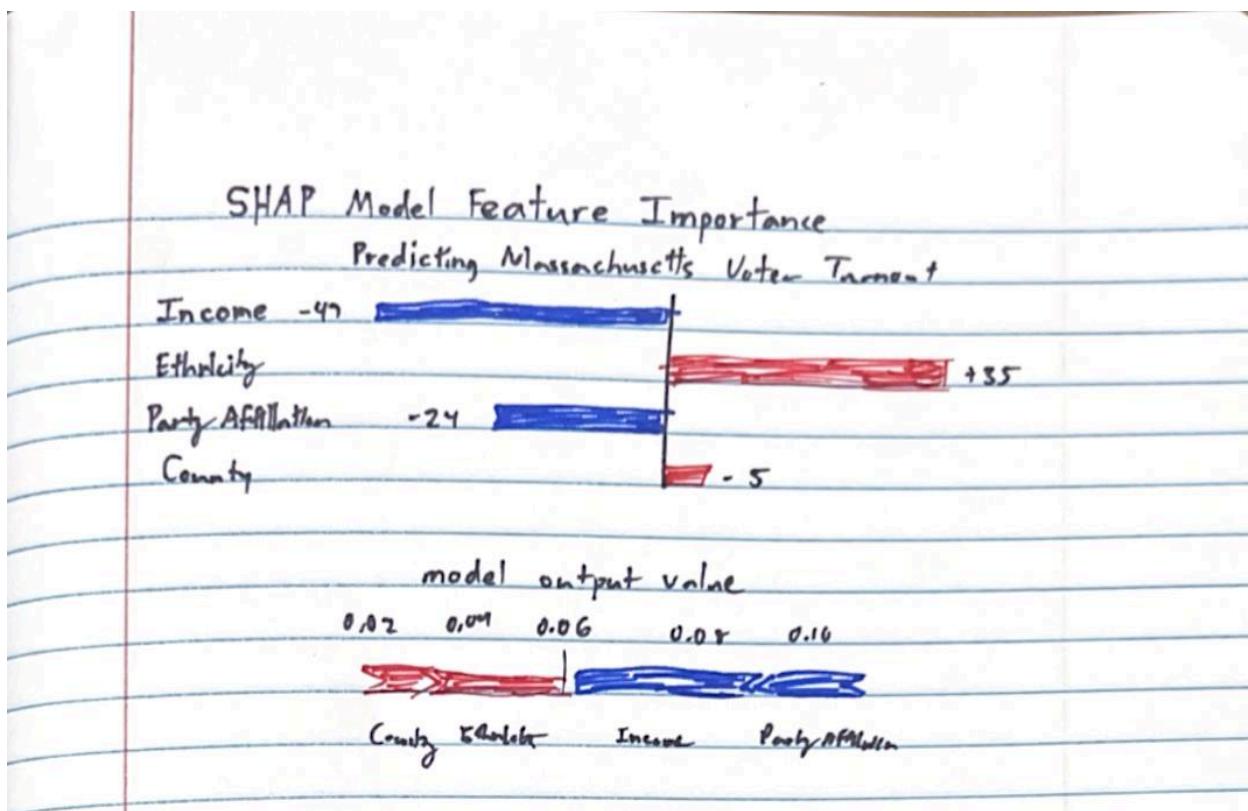


Sketch 10 (Q1, Q6, Q7)



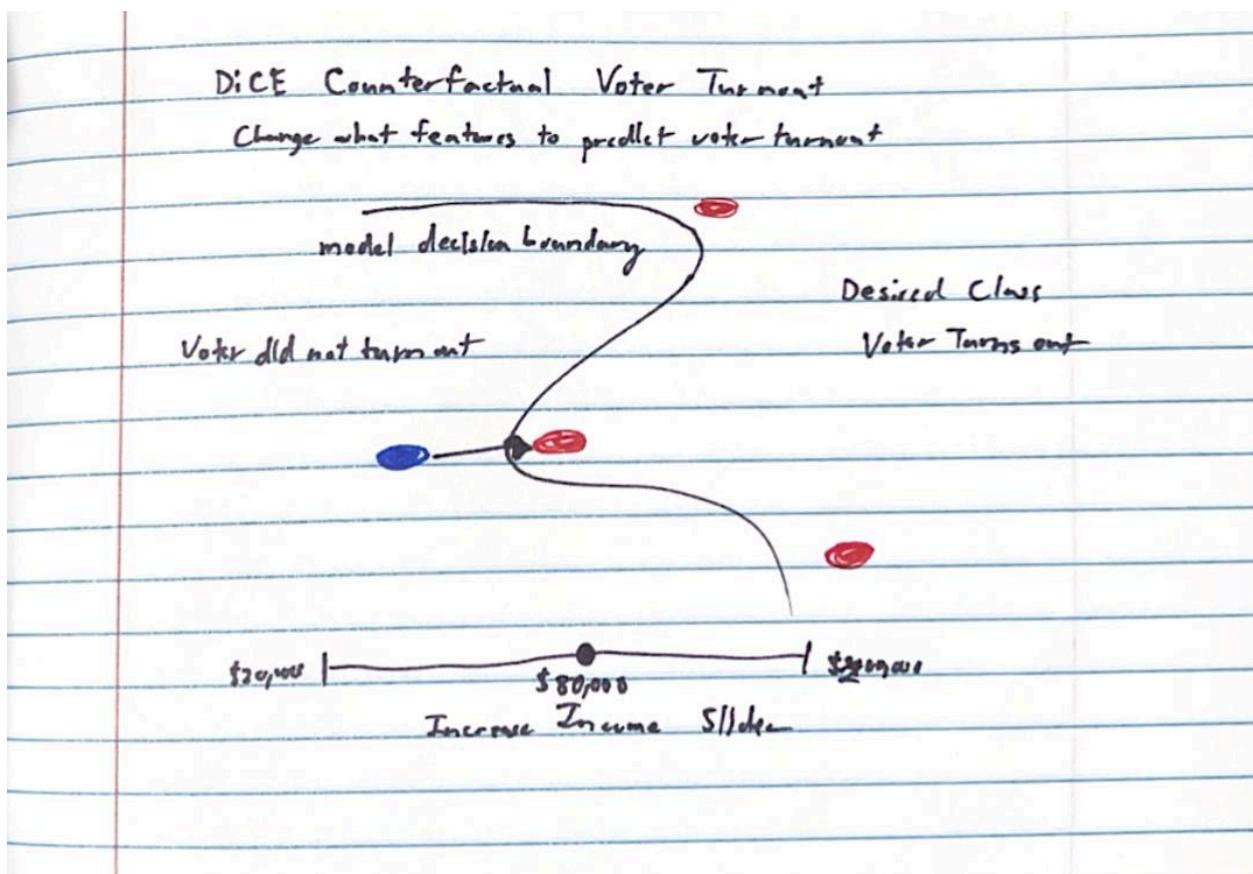
Stefan

11. How does demographics affect voter turnout in Massachusetts?

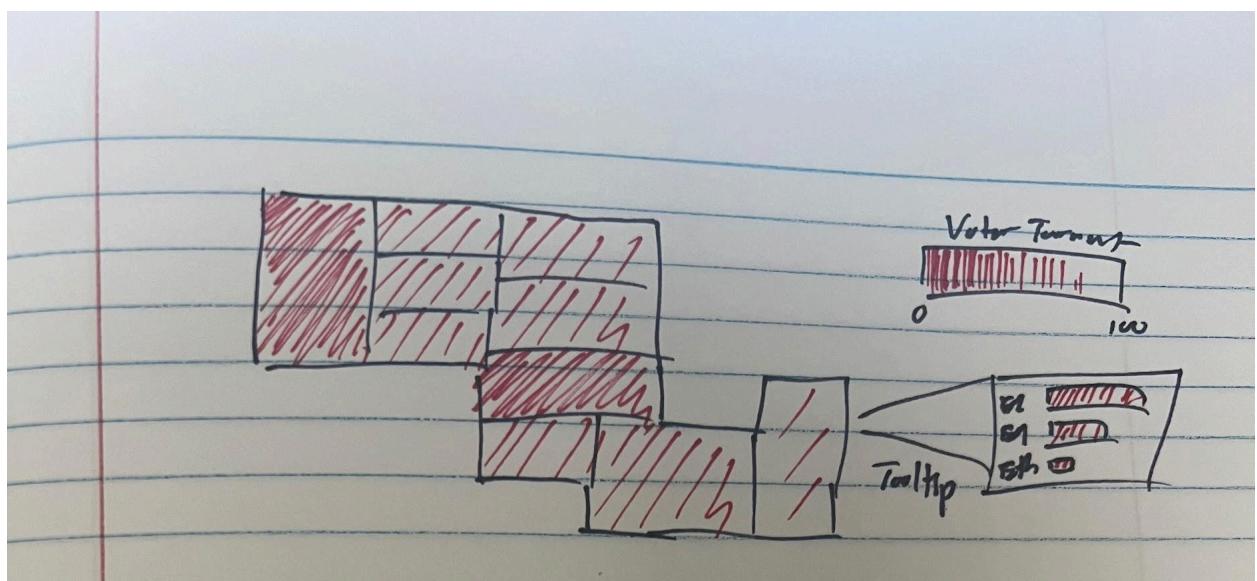


12. How does demographics affect voter turnout in Massachusetts?

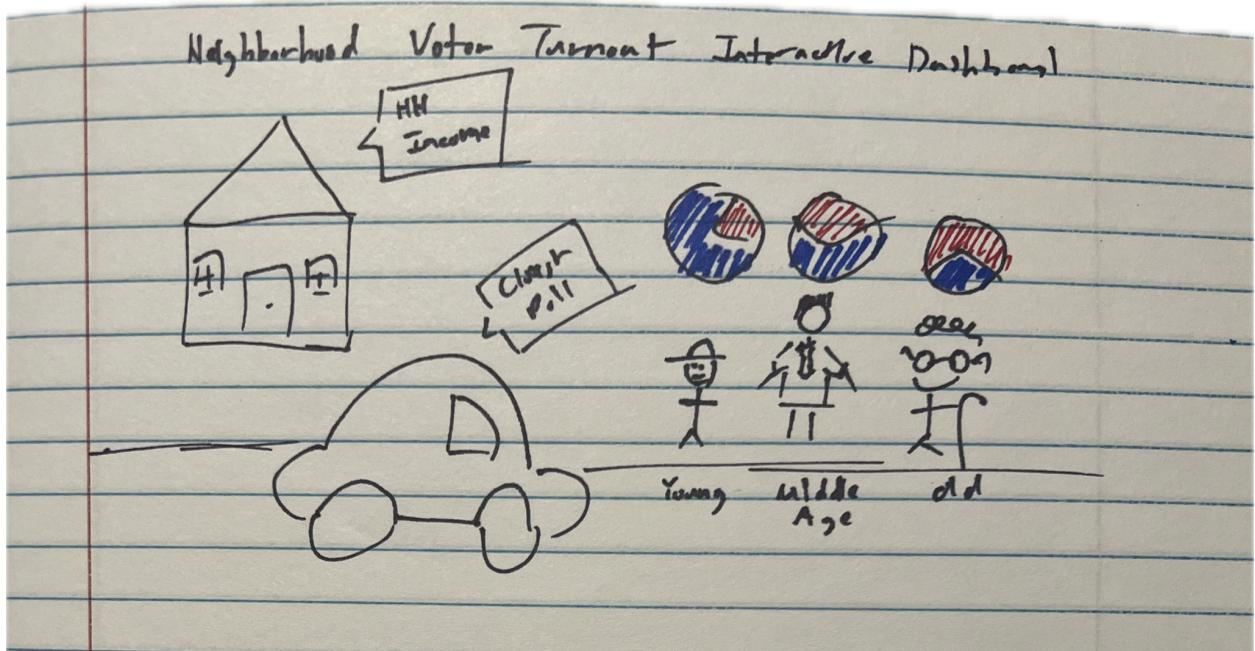
Note: At census block level, what needs to change to increase voter turnout?



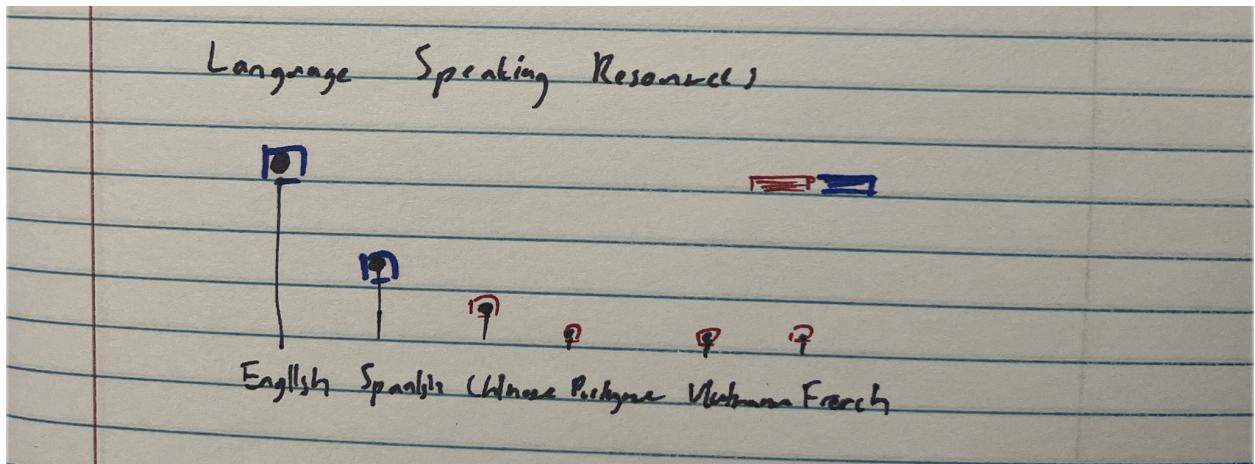
13. How does demographics affect Voter Turnout in Massachusetts?



14. What is voter turnout in my neighborhood like?

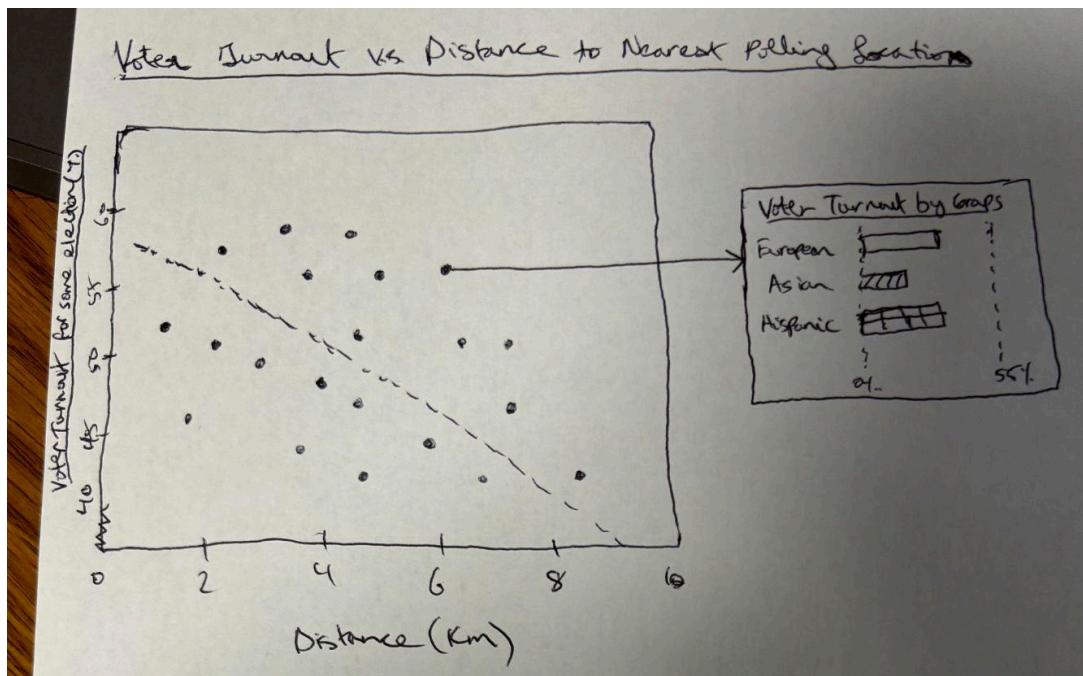


15. Language Resources in Massachusetts



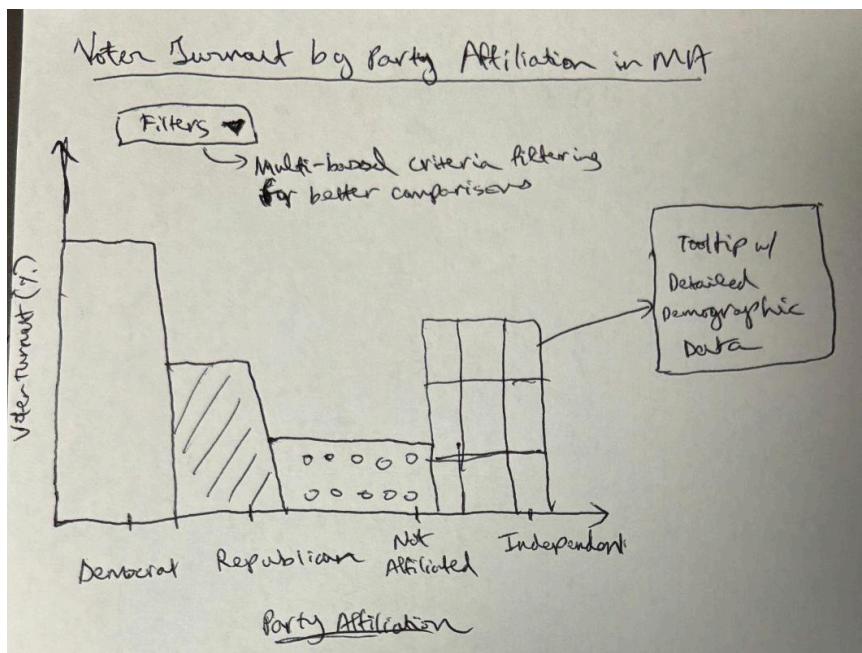
Anitej:

Sketch 16 (Q10)



- Hovering over data points shows more detailed data on ethnic groups voter turnout (%)
- We can add potential filtering based on election year, zip code, etc.

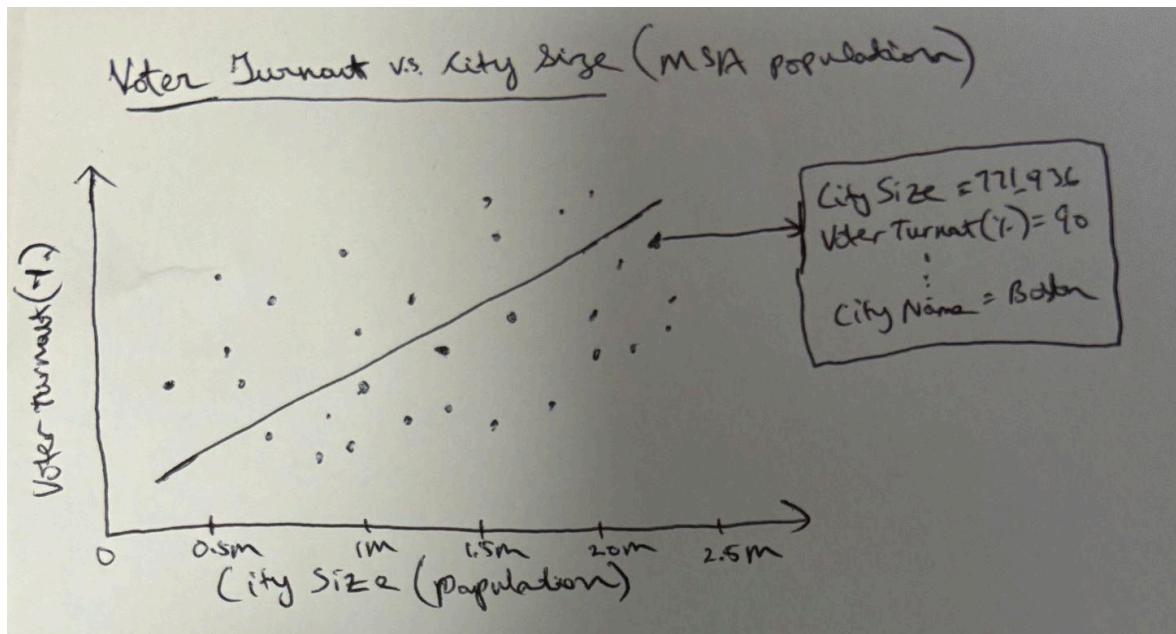
Sketch 17 (Q6)



- Tooltip for detailed demographic data

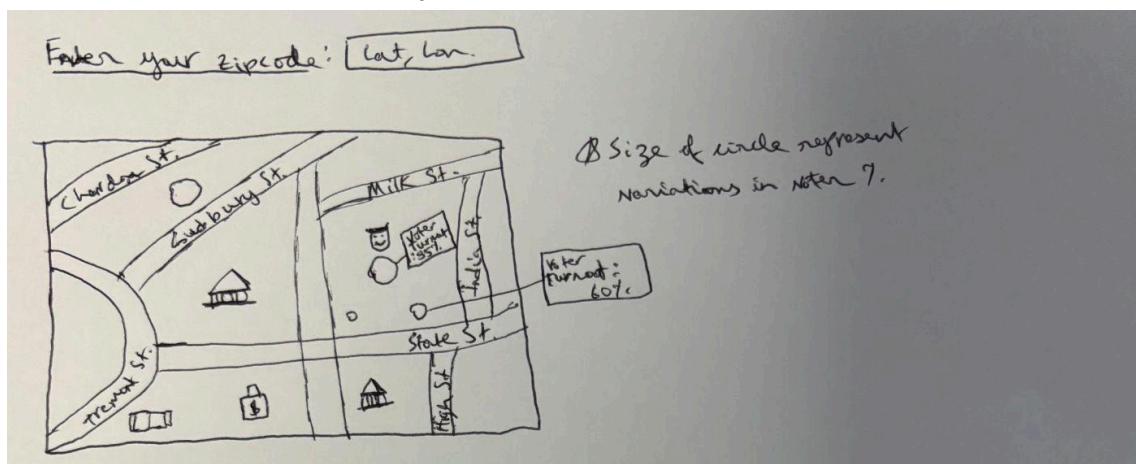
- Multi-based filtering for a more specific comparison

Sketch 18 (Q5, Q4)



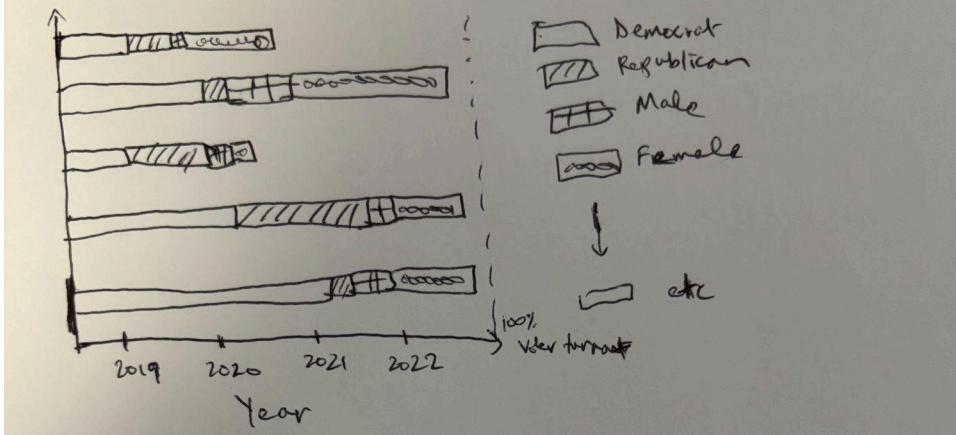
Sketch 19 (Q2)

Title: What is voter turnout in my neighborhood like?



Sketch 20 (Q1, Q2, Q9):

Voter Turnout Changes by Identity Groups



Decide

Affinity Diagramming

Sketch ID	Question ID	Author	Votes
11	1	SC	4
12	1	SC	
7	8	TM	3
2	10	MB	
16	10	AT	
9	1, 2, 5	TM	2
19	1, 2, 5	AT	1
1, 4, 6, 13	1, 3, 4, 6	MB, MB, TM, SC	4
17	1, 3, 4, 6	AT	
18	1, 5	AT	
3	1, 7	MB, SC	
10, 14	1, 7	TM, SC	1
15	1, 7		1
5	1, 8, 9	MB	2
8	1, 8, 9	TM	2

We are choosing to implement the following visualizations:

- Feature importance plot will enable viewers to better interpret our modeling results, seeing the correlation between demographic attributes and voter turnout
- Map visualization will provide much needed context to our viewers, allowing them to place themselves in the data (for example, someone living in Boston can see the demographics and voter turnout there).
- The diverging bar plot will allow users to easily see changes in value across different races, and we can add filtering for user interaction.
- Histogram of age or demographic characteristics allows viewers to see how demographics associated with voter turnout changes over different races and time.

Storyboarding

Insights

Max

- Voter turnout in the 2020 general presidential election seems to be positively correlated with mean household income at the Block Group level, Block Groups with higher income have higher voter turnout rates on average.
- Voter turnout in the 2020 general presidential election seems to be negatively correlated with the proportion of Hispanic voters at the Block Group level, Block Groups with higher percentage of registered Hispanic voters have lower voter turnout rates on average.

Ted

- The data organization by block has led to many empty blocks. For regression, we will likely work in block groups; for visualization, we may default to county.
- All counties went electorally blue in the 2016, 2020, and 2024 elections, so a map with simple party allocation will likely not be visually or informationally interesting. We need to work in degrees of change (or counts) between two elections.

Stefan

- A lot of blocks were empty and had 0 registered voters. In addition to blocks that had missing or invalid data, a total of 76,085 records were dropped, comprising 1.6% of the total population of registered voters in the state of Massachusetts. While this is only a small proportion of the dataset, it is important to gain an understanding of why the data was inaccurate.
- The census block groups that were dropped for having problems such as invalid geographic coordinates and null values showed a similar age and ethnicity distribution to the whole, suggesting that data was missing at random for reasons such as a person incorrectly inputting their address.

Anitej

- There is a significant variation in voter turnout across different ethnic groups. For instance, census blocks with higher European-descent populations show a relatively consistent turnout rate across elections, while blocks with higher Hispanic or African American populations display more fluctuation.
- Gender-specific voter turnout shows that female voter participation is consistently higher in general elections compared to males, especially in 2022.

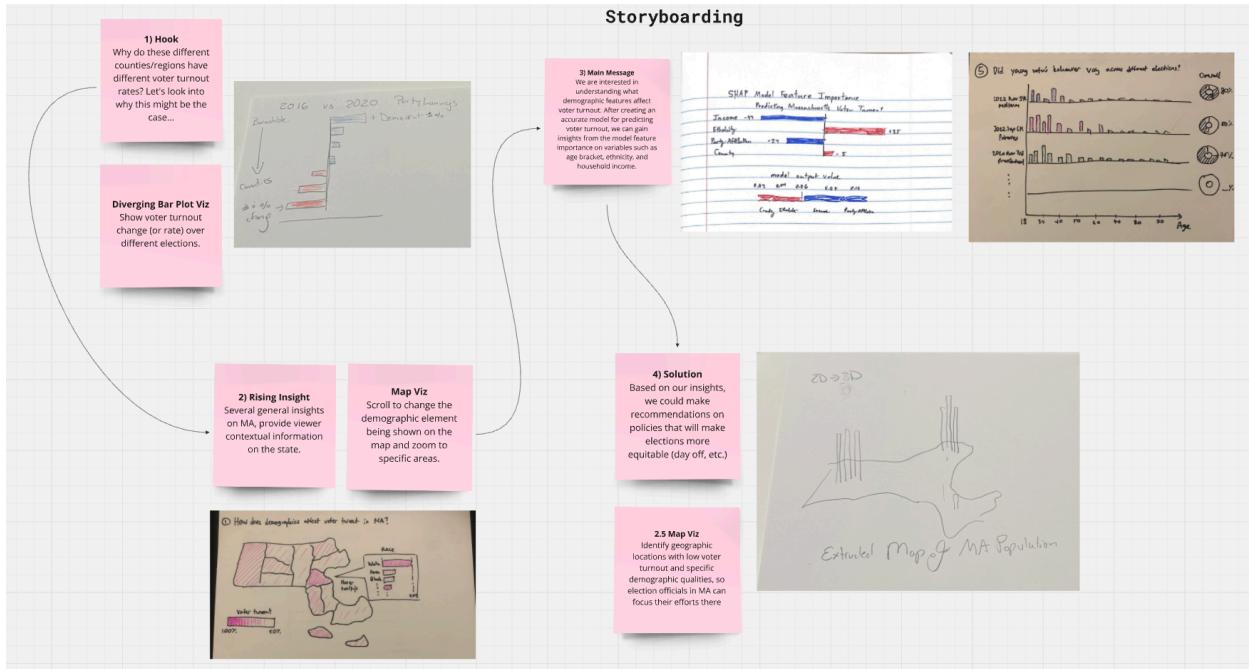
Main Insight

Different demographic groups have different rates of voter turnout, it is important to understand why to promote a fair and just democracy.

We chose this topic because:

- Multiple team members identified discrepancies in voter turnout associated with the different demographic groups.
- As a Massachusetts voter, it is important to understand that the state is composed of many different kinds of people, and how these differences in one's identity can result in inequitable outcomes.

Storyboard



Prototype v1

[Instructions](#)

Name of students that worked on prototype v1 submission

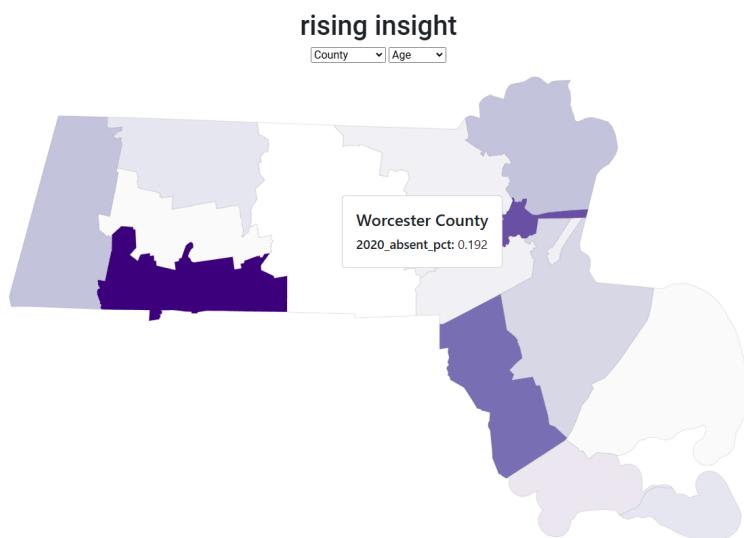
Anitej Thamma
Max Bahar
Stefan Chu
Ted McCulloch

Data scraping and cleaning complete (using the real data sets)

data/ folder contains geojson files used for visualization.

At least two D3 visualizations already partly implemented

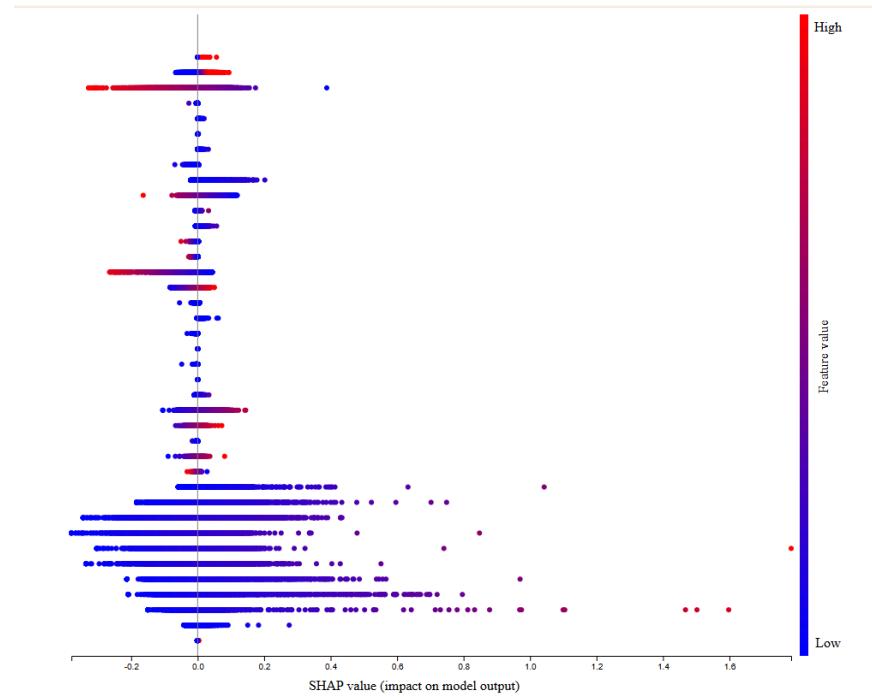
- Map visualization



- Kernel density plot

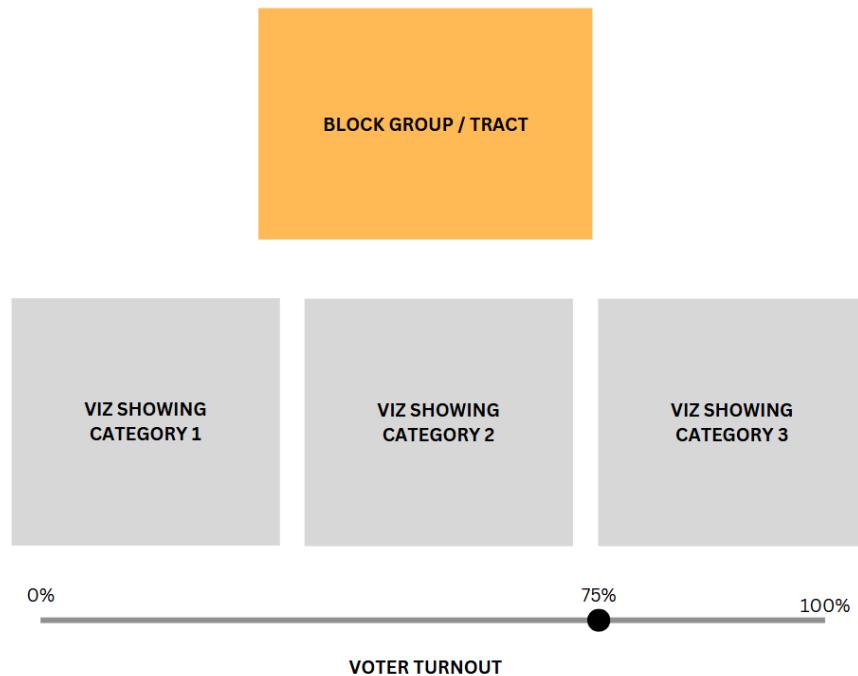


- Feature importance



Detailed drafts for 2-3 more visualizations

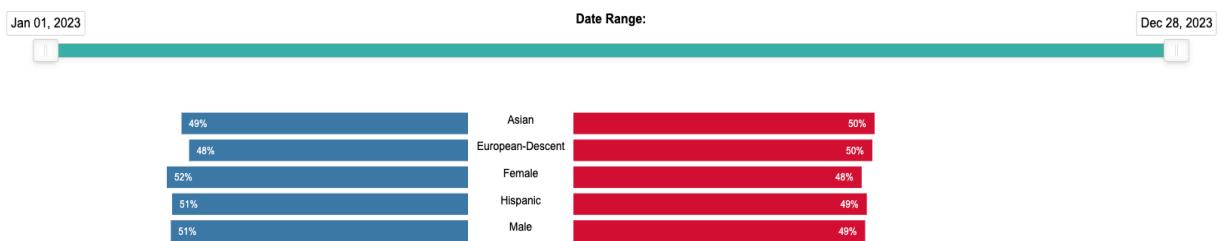
- Slider visualization



- Diverging bar plot

Demographics in Regions with Differing Party Affiliation

What are the distribution of votes?



Rough webpage design and structure

Scrolling behavior and storytelling structure is implemented.

Storytelling is clear

Hook:

- Visualization showing demographic categories in a Census Block Group, asks users to guess:
"Given this demographic composition, what would you predict voter turnout to be?"

Rising Insight:

- *Map visualization* showing that voter turnout/absence is different in different regions.
- *Map visualization slideshow* showing different demographic
- *Diverging bar plots* showing demographics by party affiliation, separate Block Groups into those with more than % of rep/dem voter registrations.
- *Kernel density plots* showing distribution of demographic proportions and correlation with voter turnout.

Main Message:

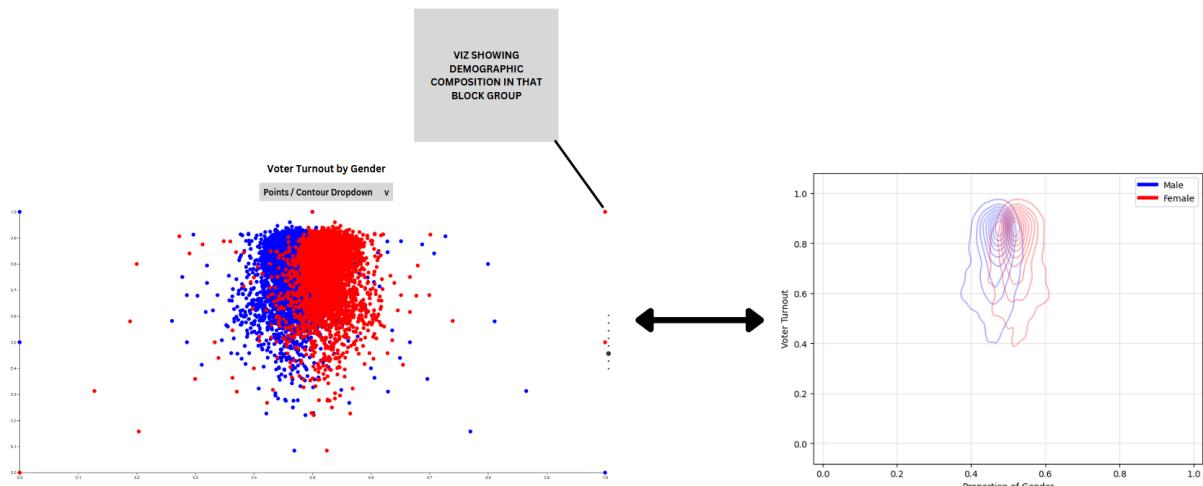
- *Feature importance plot* showing the different predictors in our model and how relevant each are.

Solution:

- How did your prediction compare to our model's prediction?

The first design of an innovative view

- *Kernel density plot*, toggle between points and contour lines.



Interactions (e.g., filtering, brushing, etc.) have to be designed

- Map visualization, interactive drop downs.
- Hook page, interactive demographic selection and voter turnout slider.

	INTERACTIVE	<table border="1"><thead><tr><th>CATEGORIES</th><th>Select up to THREE</th><th>CATEGORIES</th><th>CONTINUED</th></tr></thead><tbody><tr><td>Party Affiliation Democrat, Republican, Independent, etc.</td><td><input type="radio"/></td><td>Average Income High, Middle, Low</td><td><input type="radio"/></td></tr><tr><td>Gender Male, Female, Unknown</td><td><input type="radio"/></td><td>Spoken Language English, Spanish, Italian, etc.</td><td><input type="radio"/></td></tr><tr><td>Age Younger, Older, etc.</td><td><input type="radio"/></td><td>Ethnicity White, Black, Asian, etc.</td><td><input type="radio"/></td></tr></tbody></table>	CATEGORIES	Select up to THREE	CATEGORIES	CONTINUED	Party Affiliation Democrat, Republican, Independent, etc.	<input type="radio"/>	Average Income High, Middle, Low	<input type="radio"/>	Gender Male, Female, Unknown	<input type="radio"/>	Spoken Language English, Spanish, Italian, etc.	<input type="radio"/>	Age Younger, Older, etc.	<input type="radio"/>	Ethnicity White, Black, Asian, etc.	<input type="radio"/>	
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Age Younger, Older, etc.	<input type="radio"/>	Ethnicity White, Black, Asian, etc.	<input type="radio"/>																

Prototype v2

[Instructions](#)

To Do:

- Clean up styling for consistency
- [MAX] Be consistent with usage of voter absence vs. turnout in map viz
- [MAX] Intro slide
 - Improve histogram labels/ticks
 - Add "Massachusetts State" or make it obvious that it's not the answer.
 - UI improvements
- [MAX] Demographic Maps
 - Show better variable names
 - Improve legend labels/ticks
 - UI improvements
 - Fix tooltip rendering going off screen
 - Fix tooltip hiding behavior
 - Fix the map rendering filtering behavior, pre-load data
- [TED] Kernel density plot:
 - Interactivity
- [STEFAN] Feature importance:
 - Dodge transform
 - Color scale for individual
 - Add variable names as labels
- [ANI] Diverging bar plot: NEED TO BE EDITED
 - Change design to have each bar be a single county
 - Diverge away from the mean
- [ANI] Show the user's guess compared to our prediction.
- [MAX] Prediction Maps
 - Finalize which variables to cycle through
 - UI improvements
 - [STEFAN] Implementing the tooltip.
- [TED] Solution:
 - Call-to-action items.

Test

Instructions

For each think-aloud session, create a new copy of the feedback table below in your process book. During the session, one team member should carefully listen to the tester and document their observations and feedback in the "Notes" column. Ensure that all sections of the table are completed for each tester. If your group has 3 or more members, you must conduct at least two independent think-aloud sessions and document feedback for both.

	Notes by Stefan Chu
Tester Name	Rachel
Describe any usability issues or confusion the tester encountered while using the prototype.	<p>Title Slide</p> <p>Ballot Page 1</p> <p>Ballot Page 2</p> <p>Selection Page</p> <ul style="list-style-type: none">- What does Younger and Older mean for Age.- User confused why click doesn't work on 4th option <p>County Page</p> <ul style="list-style-type: none">- Underline Middlesex County, user thought it was a clickable hyperlink <p>Map 1 Demographics</p> <ul style="list-style-type: none">- Tooltip placeholder (not implemented) <p>KDE</p> <ul style="list-style-type: none">- What is the ratio of the groupings? <p>Diverging Bar</p> <p>Feature Importance</p> <ul style="list-style-type: none">- What is SHAP.- No mouse, scroll down.- How to read a beeswarm plot? <p>Map 2 Results</p> <p>Conclusion Page</p>
Was the tester able to understand the main message of the data story? (e.g., Yes/No +	Yes, thought the graphics complimented the message of the data story well. Main message aligned with the

why/why not?)	tester's prior knowledge of election turnout.
What parts of the interface or visualization did the tester find most engaging or effective?	Perfect amount of hover movement and selection interaction made the visualization more engaging.
What parts did the tester find confusing or less effective?	There was little instruction on how to engage with our visualizations which made it time consuming to filter through options and understand what is happening, making our plots less effective.
Did the tester encounter any inconsistencies in design, data, or narrative?	There were no legends for plot colors.
Were there any unexpected interactions or insights that emerged during the session?	Couldn't scroll through the feature importance plot with mousepad. Tester always clicked the first option to test out what happens.
What specific improvements or changes did the tester suggest for the prototype?	We had a lot of innovative, but complicated plots that the average person doesn't read very often. Need more instructions or guidance.
Did the tester suggest any additional insights or visualizations to include?	Wants more information on corruption such as gerrymandering, redistricting by name, etc that we conclude with in our main message.
General observations or comments from the tester.	Smaller font. "This page" is not clear Contrast with red font. More categories written out such as Spoken language Select up to 3 of the 6. Merge the top categories part Unclick to click the other. Undo the last clicked option. User confused why click doesn't work on 4th option. Fewer ticks on the x and y axis. Too busy Put the 2020 average turnout at the top.

	Notes by Ted
Tester Name	Mariam
Describe any usability issues or confusion the tester encountered while using the prototype.	Title Slide Ballot Page 1

	<p>Ballot Page 2</p> <p>Selection Page</p> <ul style="list-style-type: none"> - Confusion about definition of mean income; suggest we change to average <p>County Page</p> <ul style="list-style-type: none"> - Confusion about county selection - Wanted to select county - Suggested that we underline county name in same purple color as map is <p>Map 1 Demographics</p> <ul style="list-style-type: none"> - No stated confusion but spent some time figuring map out <p>KDE</p> <ul style="list-style-type: none"> - Wanted instructions in the about or some description of functionality - Was trying to click the KDE plot for more information <p>Diverging Bar</p> <ul style="list-style-type: none"> - Took about 15-20 seconds to read instructions - Confusion about variation from mean - Wanted instruction - Didn't understand where second party comes in - Republican should be red and democrat should be blue <p>Feature Importance</p> <ul style="list-style-type: none"> - Unable to scroll - Gradient bar being cut off made her confused about what the graph was representing <p>Map 2 Results</p> <ul style="list-style-type: none"> - Wanted to know how the map differs from the first map <p>Conclusion Page</p> <ul style="list-style-type: none"> - Making voting more accessible hard to read at current opacity
Was the tester able to understand the main message of the data story? (e.g., Yes/No + why/why not?)	Yes. Overall very positive feedback. Liked the flow of the presentation and thought the ordering of the information was natural/effective.
What parts of the interface or visualization did	She praised the aesthetic multiple times.

the tester find most engaging or effective?	She found the voting and the selection review to be very cool Really loved the last map page with her prediction, the true value, and our model's prediction
What parts did the tester find confusing or less effective?	Some small points of confusion (documented extensively in first question). Mostly about whether or not things are clickable/need some supporting information to understand the plots
Did the tester encounter any inconsistencies in design, data, or narrative?	Was confused by the colors in the diverging bar plot; suggested they not be randomized
Were there any unexpected interactions or insights that emerged during the session?	Everyone voted for Max >:(had difficulty scrolling on the feature importance plot
What specific improvements or changes did the tester suggest for the prototype?	Wanted more about or instructions on some of the more complicated visualizations
Did the tester suggest any additional insights or visualizations to include?	For diverging bar plot suggested that counties be sorted Suggested hyperlinks or references in the conclusion section
General observations or comments from the tester.	<p>Title Slide</p> <ul style="list-style-type: none"> - Liked the title slide <p>Ballot Page 1</p> <ul style="list-style-type: none"> - Skipped first page to look at second page and then went to first - Voted for Max <p>Ballot Page 2</p> <ul style="list-style-type: none"> - Liked the interactivity of second page <p>Selection Page</p> <ul style="list-style-type: none"> - Liked the aesthetic of this - Suggested we say average not mean <p>County Page</p> <ul style="list-style-type: none"> - Color suggestion that county name match map color - Tried to select county - Asked for a submit button or something to indicate her guess was recorded <p>Map 1 Demographics</p> <ul style="list-style-type: none"> - Enjoyed clicking by county - Nantucket cut off

KDE

- Liked the about
- Suggested instructions or addition to about about functionality

Diverging Bar

- Wanted instructions and style cohesion

Feature Importance

- Scrolling issue and confusion about scale because of bar being cut off

Map 2 Results

- Complimented aesthetic
- Asked how this map was different from first

Conclusion Page

- Readability of first suggestion
- Asked for references and hyperlinks

Discuss the results of the think-aloud study in your team. In your process book, answer the following questions:

- Based on the results of your ‘think aloud’ study, what would you improve in your data story?
 1. Add references or hyperlinks to our concluding section.
 2. Include more basic information about the model, what features were used, etc.
 3. County selection.
 - a. Allow users to click on the selected county to choose which county to guess for.
 4. Include more visual cues for the slider.
 - a. Change gray text to black text to indicate the user has made changes to it.
 - b. Move MA state average to the top, right below the main question, keep the slider at the bottom.
 - c. Make the slider more obvious, add color or make the border thicker, etc.
 5. Map improvements
 - a. Make the border thicker or more prominent so all-white counties are not as confusing for viewers.
 - b. When hovering don’t change the color, only change the outline.
- Are there any additional insights and visualizations you would use? Would you amplify or change your message? Did your narrative work? Did the tester get your takeaways?
 - Based on our testing, all the testers found the narrative to be effective.
 - We feel that adding visualizations will not add to the data story, we will choose to improve our current visualizations and our explanatory text.
- Decide as a team which of these improvements you will implement and write down your decisions and why you made them in your process book as a numbered list.
 1. Add references or hyperlinks to our concluding section.
 - Add more credibility to our data story.
 2. Include more basic information about the model, what features were used, etc.
 - Explain the model to viewers who may not be familiar with modeling.
 3. Allow users to click on the selected county to choose which county to guess for.
 4. Change the underline of the county to the same color as what’s displayed on the map.
 - Add more interactivity to engage viewers.
 5. Include more visual cues for the slider.
 6. Change gray text to black text to indicate the user has made changes to it.
 7. Move MA state average to the top, right below the main question, keep the slider at the bottom.
 8. Make the slider more obvious, add color or make the border thicker, etc.
 9. Extend the blue gradient to the slider voter turnout page, hopefully making it more obvious that the slider is interactive.
 - Make it more obvious that the slider UI item is interactive.

10. Make the border thicker or more prominent so all-white counties are not as confusing for viewers.
 11. When hovering don't change the color, only change the outline.
 12. In the model results map, add an underline or emphasize the word "Predicted" making it clearer which map is being displayed.
 - Improves readability of the maps.
 13. Change the format of the first ballot page, to make it more readable.
 14. Add our names to the last slide of the data story.
- Implement the intended changes and check them off your list (e.g., adding "done"). You can distribute the tasks among your team members. If you are unable to implement specific changes, please explain why and describe the expected results in your process book.
 - General Changes
 - **[IN PROGRESS]** Potentially use [blueprint.js](#) for color coordination.
 - Introduction Page
 - **[DONE]** Change the format of the first ballot page, to make it more readable.
 - Slider Page
 - County selection:
 - **[DONE]** Allow users to choose which county to guess for by clicking on the map.
 - **[DONE]** Change the underline of the county to the same color as what's displayed on the map.
 - Visual cues:
 - **[DONE]** Change red text to black text to indicate the user has made changes to it.
 - **[DONE]** Move MA state average to the top, right below the main question, keep the slider at the bottom.
 - **[DONE]** Make the slider more obvious, add color or make the border thicker, etc.
 - **[DONE]** Extend the blue gradient to the slider voter turnout page, hopefully making it more obvious that the slider is interactive.
 - Map Demographics
 - **[DONE]** Make the border thicker or more prominent so all-white counties are not as confusing for viewers.
 - **[DONE]** When hovering don't change the color, only change the outline.
 - **[DONE]** Fix tooltip rendering for the Southeastern counties.
 - Diverging bar plot
 - **[DONE]** Add text explaining the drop downs on the plot.
 - **[DONE]** Potentially use a diverging color scale instead of a solid fill for the bars, showing the proportions of both parties instead of just the majority.
 - New slide explaining the model.

- **[DONE]** Include more basic information about the model, what features were used, etc.
- **[DONE]** About the dataset, about the model, etc.
- Feature Importance
 - Optimize the calculation of offsets to reduce loading times.
- Model Results Map
 - **[DONE]** Add an underline or emphasize the word “Predicted” making it clearer which map is being displayed.
 - **[DONE]** Add the waterfall SHAP local feature importance tooltip.
- Last Slide
 - **[DONE]** Add our names to the last slide of the data story.

Final Submission Deliverables

To Do

- Website Improvements:
 - Maps:
 - [DONE] Fix/improve zooming behavior.
 - General:
 - [DONE] Tweak margins and styling if needed.
 - If we have time, update the scale on window resize.
 - Explanation Slides:
 - [DONE] Add more color to the Random Forest slide.
 - Diverging Bar Plot:
 - Use a gradient instead of a solid fill for the parties.
 - Use a consistent legend for the bars.
 - Update height to be dynamic.
 - Feature Importance Plot:
 - [DONE] Generate predictions for MA using the latest model.
 - [DONE] Use the subset of 13 important predictors.
- Video:
 - One person records a brief 2 minute run through of the website.

Process Book

- Probably can submit as is.

Data

- Include geojson and csv files in the zip.

Code

- [DONE] Make sure to clean up any comments/internal notes before final submission.

Video

- 2 minute screencast with narration.
- One person could probably do this.

ReadMe

- Done

Requirements

- Process Book
 - The process book is complete and clearly documents the progress throughout the design sprint
- Final Project Video
 - The video can be viewed by the TFs and the maximum length is 2 minutes
 - The video has a spoken narration that presents your data story and interactive visualizations
 - The video and narration are appropriate for a general audience
- Effectiveness of Visualization and Interaction Designs
 - Proper use of colors
 - Effective charts and visual encodings
 - Engaging and useful interactions for the visualizations
 - Follows the design guidelines and principles you learned in this course
- Technical Requirements
 - Implemented multiple coordinated (linked) views
 - Implemented at least one innovative visualization that is either
 - a) an extension of an existing visualization type, or
 - b) a novel visualization type
 - The goal of an innovative visualization is to go beyond typical bar charts or line charts, be creative! Come up with custom visualizations that only work for your type of data!
 - Your final website should be robust, reliable, and polished