DS4200 Project: Visualizing Food Insecurity

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ABSTRACT

More than 34 million people experience food insecurity in the United States according to the USDA. Despite the general presence of food stamps and assistance programs, food accessibility still remains difficult to navigate. We present a task abstraction and visualization for policy makers to create informed solutions based on patterns and trends in grocery prices and food stamps to help better distribute necessary aid.

Index Terms: Food Insecurity – Food Stamps – Accessibility – Visualization

1 INTRODUCTION

Food insecurity is defined as, "a household-level economic and social condition of limited or uncertain access to adequate food" according to the Office of Disease Prevention and Health Promotion. The conceptualization of food insecurity in the United States is generally regarded differently compared to other countries. For example, nutritional foods tend to be more expensive than cheap calorie high foods. Lower income countries experience insufficient access to nutritional and calorie filled foods. However, discovery of the individual states' access to food compared to food prices can provide a smaller-scaled model for addressing even global food insecure challenges.

Our aim is to provide a clear map visualization of the price per food category in each state of the United States compared with the food stamp usage. As a result of time-stamp data we can make comparisons between these two variables over time as well. With this information, policy makers can not only expand food programs, but effectively distribute assistance to where it is needed. This will, in return, support households, communities, and services with a plan for receiving immediate aid instead of questioning where to look for help. Users will be able gain an understanding of the distribution of different food prices in order to make clearer decisions. With an actionable approach, there can be a more operative impact.

2 RELATED WORK

Increased attention to food insecurity has shown to be pertinent in finding solutions as illustrated in Seth Berkowitz and Hilary Seligman's article titled, Aligning Programs and Policies to Support Food Security and Public Health Goals in the United States [1]. A specific framework visualization is provided in the paper for analyzing food insecurity coping strategies through 4 subcategories: individual, household, community, and policy levels. With a focus on cost-saving strategies and grocery store prices, this information will prove to be important in specifying different groups impacted in our visualization.

Another paper by Elton Mykerezi and Bradford Mills titled The Impact of Food Stamp Program Participation on Household Food Insecurity [2] details some interesting factors about Food Stamps that should be considered in our visualization. Mykerezi and Mills speak of how effective the food stamp program is in actually solving food insecurity issues. As our visualization will compare how food prices and food stamp usage correlate, we must also acknowledge what was found in this paper, such as the impact of losing food stamp benefits.

3 USE CASE

Our target user will be policy makers looking to understand the impacts of food prices and access to food on different demographics in the US by state. A policymaker has a theory that an increase in food prices leads to an increase in food stamp usage. There is general data to back it up, but there is no concrete visualization to compare the trends of prices and stamps. Policy makers face challenges with designing and implementing effective policies for addressing food insecurity and improving access to food for low-income households. Food stamps are a tool used to address this issue, but there are many complex and interrelated issues that they have to consider when analyzing the effectiveness. For example, a policy maker, as a target user, might want to know the unit price of grains from 2020 to 2021 in Massachusetts and the food stamp usage. They first move the year slider to 2020 and select "grains" from the dropdown. After, they can click Massachusetts on the map and view the two line charts that pop up. They can then do the same thing for the year 2021. From 2020 they can see that the unit price of grains was between 2.45 and 2.75 dollars and the population of people using food stamps was around 13 percent. On the other hand, in 2021 the unit price was between 2.68 and 2.90 dollars and the percentage of the population using food stamps was well over 14 percent. Generally, as the unit price for grains increased, the amount of food stamp usage also increased. From this information they need to look at the trade-offs between immediate relief and promoting long-term self-sufficiency. In this situation immediate relief would be needed during 2020 as COVID caused an increase in prices. They need to look at the impact of the economy and the effects of food distributors and retailers. It is important to consider the changes in consumer behavior through food stamp usage and food prices to analyze the overall landscape of food assistance programs. By using a map of food stamps and unit price, policy makers can also track the effectiveness of their efforts to combat food insecurity over time. They can monitor changes in the availability and cost of healthy food options in targeted areas, as well as changes in food stamp usage, to determine whether their interventions are having the desired impact. By analyzing the map of food stamps and unit price, policy makers could identify regions where the cost of food is higher than average and if food stamp distribution should be increased. They can also determine if food insecurity and food prices improve over time.

4 DATA

Within our project, we plan on using and visualizing two different datasets. These two datasets contain information about food stamp usage by state over time, as well as grocery prices by state and food category over time. The data from both of these datasets are collected by the U.S. Department of Agriculture (USDA). The **data about grocery prices** is collected by Information Resources Inc. and updated and managed by the USDA Economic Research Service

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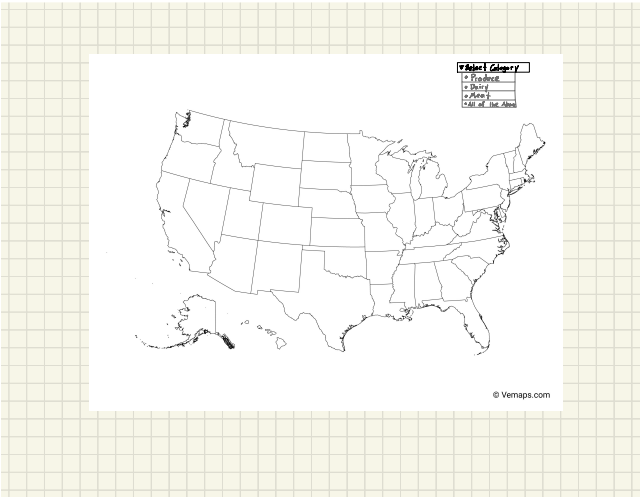
(ERS), while the **data on food stamp** usage is provided and managed under the USDA Food and Nutrition Service (FNS).

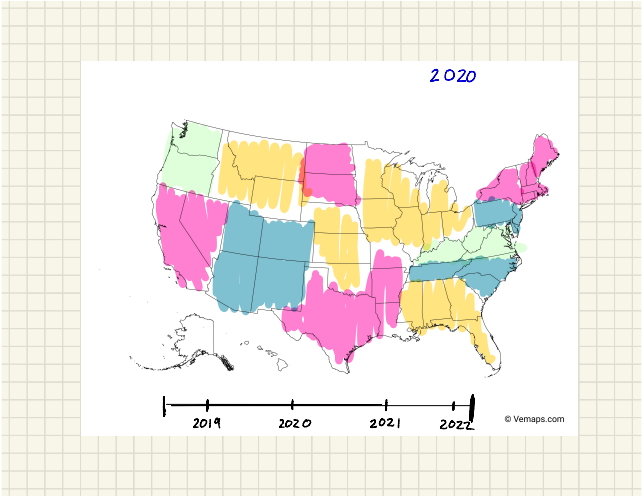
Since both of our datasets are provided directly from agencies of the federal government, there shouldn't be too much bias or ethical issues. The weekly grocery prices are collected by Information Resources, Inc. (IRI) using a nationally representative sample of retail food establishments and USDA's ERS updates this data for the public monthly. There is a possibility for bias in this dataset because IRI does not collect data in 12 states/areas: Alaska, Delaware, Hawaii, Idaho, Iowa, Kansas, Nebraska, New Jersey, North Dakota, Mississippi, Montana, and Washington, D.C., so we have some missing information.

We were unable to convert the food stamp data into csv files because the data was broken up into various sheets dependent on region within the same excel file. Therefore, we had to reformat the data into one sheet for each fiscal year first in order to export the data as csv files. In this process, we decided to drop the number of households, total cost, and cost per household columns, leaving us with the data for number of persons and cost per person. In order to determine the proportion of the population that uses food stamps in each state, we merged the food stamp dataset with a state population dataset by state and year. With this, we derived the new attribute of percentage, dividing the count of people using food stamps by the state population for that specific state and year, determining the proportion of people in that state using food stamps. For our grocery prices dataset, we dropped all rows of data from December 2022, since we did not have data on that time period for the food stamps dataset. Furthermore, we derived the new attribute of unit price by dividing the total dollars by the unit sales in order to determine the cost per item.

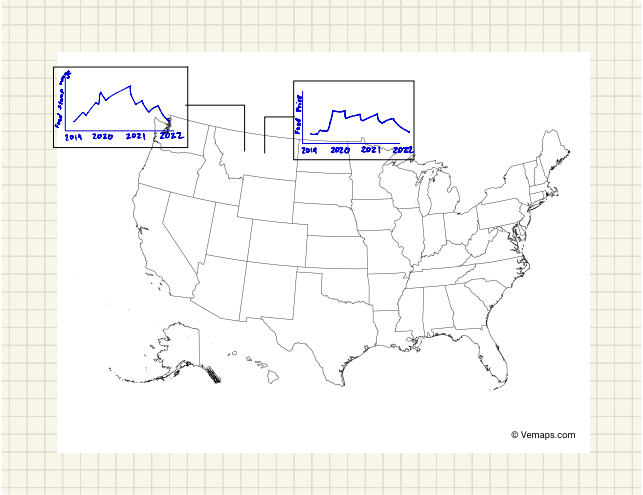
5 Design Process



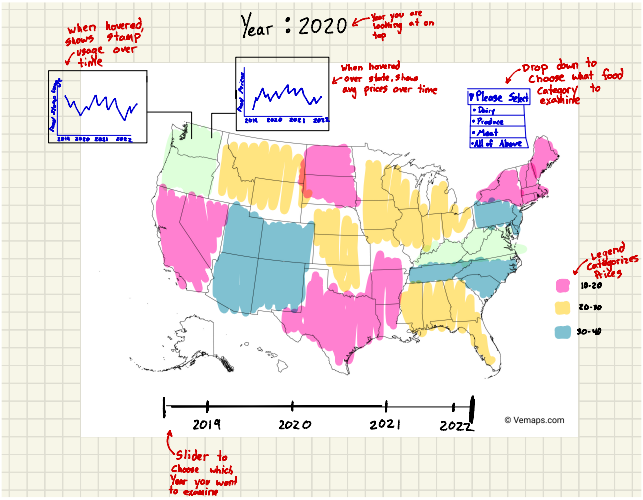
This intial sketch started with the idea of a dropdown menu in the top right corner where you can filter by the type of food and examine the prices in each state.



This next sketch features a slider where you can examine how the average food prices have changed over time.



The third sketch focuses on a hover menu that pops up when you go over specific states. Two line charts will pop up when you do this, one showing how prices in that specific state has changed over time, the other showing how the use of food stamps in that state have changed over time.



The final sketch includes all of the above components into one graph. There is a drop down menu to filter by type of food item, or you can look at the average. The current year you are looking

at is displayed at the top, and you can use the slider at the bottom to adjust that. The same hover graphs still exist, where you can compare line charts of how food stamps and food prices in a specific state have changed over time. The sketch utilizes color and area as well as shape to signify the marks and channels of the visualization.

Changes in the Design Process

- Hover Line Charts → On click Line Charts
  We decided to change how the line charts that show state-specific food stamp usage over time and average unit price over time show up. Originally, we planned to have the line charts show up when a user hovers over a certain state; however, we determined that this functionality wasn't indicative of the line charts' purposes to analyze the trend over time. Identifying trends takes more than a split second. We wanted users to be able to view the line charts comfortably for a longer period of time in order to analyze the data and discover the trends.

- Categorical Legend → Gradient Legend
  Our data being mapped onto the states is quantitative in nature as average unit price. Thus, we decided that a gradient legend would be more applicable to visualize the different values rather than a categorical legend, since price is continuous and would not be well represented by categories of colors. Since we decided to simply make the states without data white, we decided to make the gradient from green to yellow to red in order to have enough distinction and contrast between states with and without data.

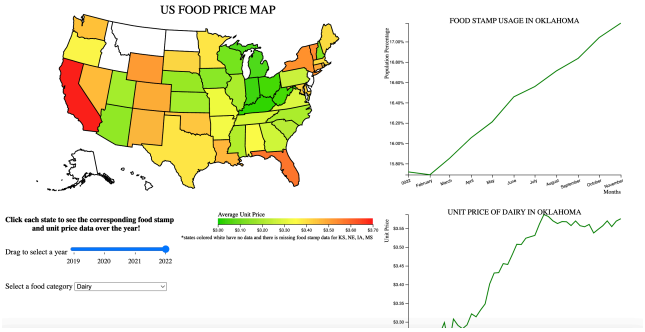
- Removing "all of the above" choice from category dropdown
  After reviewing our data, we decided that the "all of the above" choice would not be extremely applicable or add much to our visualization. Our original plan for this dropdown choice was to average all the prices from each category, however due to the difference in prices between each category, there wouldn't be much use in averaging the values out. As the purpose of this visualization does not really include knowing the average prices of all the food categories together, we decided that this was not necessary to include in our final visualization.

- Moved all user inputs to bottom
  We decided to have both of the user input functionalities at the bottom left of the visualization. Originally, we had the year slider at the bottom and the food category dropdown at the top, but we realized it would be much easier for the user to have them in the same location.

Usability Testing

This first task we gave users was to determine the average unit price for fruits in Massachusetts in 2022 and determine whether fruit was relatively expensive or inexpensive compared to the rest of the country. We chose this task because users should be able to obtain specific information for each state as well as compare it to the other states. It is also important for users to be able to understand how to find the specific unit price for a state at a certain year and in a certain category. Since we live in Massachusetts, we chose to ask users the average unit price of fruit in Massachusetts and compare it to the rest of the country. For the second task, we asked users which states had the highest and lowest average unit price for dairy in 2020. It is interesting to see which states have the most expensive and the least expensive food items and see how the answers differ among different food categories. Our third unit task focuses more on the usability of our line charts and asks users to determine if the alcohol unit prices increased or decreased Alabama between March to April. The line charts provide more specific information by month on the trends of food prices in a specific year, so we wanted to test its effectiveness. The point of these line charts is for users to visualize how the prices change over time on a more detailed level than that which is shown on the map. Thus, asking users to interpret the trends over a specific set of months would ensure that our visualization is being effective for its purpose. Similarly, with the fourth unit task, it will also see if users can interpret the trends for stamp usage in Alabama to determine how it has changed over time in a specific year.

6 Final Design



On the left side of our visualization, we have a map that is color coded based on the average unit price of different categories of food for 4 different years. We have a slider where you can change the year you are viewing, and then a drop down that changes the category of food you are viewing. There is also a gradient legend so you are able to determine the price of the food. You can then hover your mouse over any specific state to see the exact unit price in that location. To use the right side of our visualization, we have implemented a clicking interaction. When you click on a specific state, these two line charts will show up. The top chart showcases the food stamp usage in that specific state for the year you are currently viewing. The bottom line chart shows the change in the unit price of food in that state for the year you are currently viewing. By having these two charts right on top of each other, you can easily view any change and correlation between the two variables.

As stated earlier in our use case, a policy maker could use this visualization to explore what states need a greater assistance in food accessibility. For example, the policy maker is from Massachusetts and want to see how the usage of food stamps has changed in the past four years in relation to the price of food. The policy maker will first put the slider on 2019, and then choose a specific food category to examine such as "Fruits". They can then click on Massachusetts, and the food stamp usage will appear over the course of that year. They can then move the year slider to 2020, 2021, or 2022 to see what the usage is in those years. From this exploration with our visualization, the policy maker can make better informed decisions about accessibility to food.

7 Discussion

Our visualization addresses the foundation of the food insecurity domain problem we set out to solve, however there are many ways it could address it more. For one, some data is unaccounted for because the dataset we used doesn't include food prices or stamp usage for certain states. Therefore there are missing values and misrepresentation. Additionally there are limitations with the specificity of the information. The map shows a generalized view of the states instead of certain locations. The year range is also small so it is difficult to discern a drastic change in prices and stamp usage. In the future, if we wanted to make improvements, we would want to collect more data specifically within each state. For example, if we

had data within the county or zip code level, the visualization could be more applicable to local individuals who might want to compare food prices more accurately to where they live. We would also want to plot food stamp usage directly with unit price per food category to investigate the relationship between the two variables more closely. Overall we would want to hone in on more specific locations and data trends to gain a deeper understanding of food distribution and consumer activity. If we solidify specificity in this model, it can be used as an example for other struggling countries who can look to the United States as a guide.

8 Conclusion

After intensive data investigation, and javascript implementation, we designed and created two visualizations to help understand two key factors of food insecurity; food stamps and food price. We created an overview for policymakers to evaluate the trends that these two variables result in. With our visualization, policy makers can develop and infiltrate solutions to best combat the lack of resources for a particular state and whether or not more stamps need to be allocated. To conclude, our goal was to raise awareness about food insecurity and provide actionable steps for policy makers, individuals, and communities to take in addressing this critical issue.

9 Appendix

Task Abstraction
Domain Task 1: Food stamp and price comparisons
Query: (Compare) Comparing the trends of food prices and food stamp usage in an individual state, can also compare prices between different states
Search: (Lookup) Since the visualization is a map of the US, users would easily be able to locate the information from states that they are interested in
Analyze: (Discover) Policy makers will be able to explore and discover info about different data based on the states and food categories they are interested in
Target: (Trends) Looking at trends of food prices and stamp usage over time
Description: Comparing food stamps and food prices is a lookup task as the state location and intended interest is known. The user/policy maker must discover the trends and patterns that the data reveals
Domain Task 2: Determining food category prices
Query: (Identify) User needs to be able to identify the categories that certain food prices fall under
Search: (Browse) If the policy maker or user doesn't know which specific food category to look at, but the location is of the state is known
Analyze: (Discover) Users will be able to explore and discover info about different data based on food categories they are interested in
Target: (One Attribute) Looking at distribution of prices
Description: Determining food category prices is a browsing task, as the user may just want more information in general for a specific state

Data Abstraction
Each row in the grocery prices dataset represents the price of a specific category of foods in a specific state during a specific week and each row in the stamps dataset represents the food stamps usage for a specific state during a specific month. The date attribute in both datasets would be considered an ordinal data type, as the data represents elapsed time. The state attribute in both datasets would be considered a categorical data type. The category attribute in the grocery prices dataset would be considered a categorical data type. The dollars, unit sales, and unit price attributes in the grocery prices dataset would all be sequential quantitative data types. The persons, cost per person, population, and percentage attributes in the stamps dataset would all be sequential quantitative data types.

References

[1] H. K. Berkowitz, Seth A.and Seligman. Aligning programs and policies to support food security and public health goals in the united states. *Annual Reviews*, 40(1):319–337, 2019. doi: 10.1146/annurev-publhealth-040218-044132

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