Aging in Place with ElderNet

An datathon organized by R-Ladies Philly & Data Philly

2/16/2022 - 4/15/2022

Background

The "Aging in Place" datathon aimed to connect and enable data science enthusiasts in the Philadelphia region to learn and collaborate, while exploring how ElderNet's programs for elderly and disabled individuals can serve the community now and in the future. Data analyses were completed by participants in three groups, each focusing on one of the following main topics: 1) ElderNet's impact in the community, 2) an insights dashboard to support decision-making, and 3) growth opportunities and new ideas.

Partners

ElderNet of Lower Merion and Narberth is a nonprofit organization that was founded in 1976 by representatives of community, religious and governmental groups. ElderNet serves adults of all ages, especially frail older or younger disabled persons with low to moderate incomes who reside in Lower Merion or Narberth. ElderNet helps older neighbors remain independent and provides a variety of free, practical services so they have access to healthcare, food security, and an improved quality of life. ElderNet also provides information to individuals who need assistance with housing, nursing care, or other necessities. ElderNet served as the sponsor for this datathon, providing data and invaluable subject matter expertise.

R-Ladies Philly is the Philadelphia chapter of R-Ladies Global, promoting gender diversity in Philadelphia's data science community through informal monthly workshops, happy hours, and real-world data analytics projects.

DataPhilly is a community run group in Philadelphia for anyone interested in gaining insights from data. Topics include (but are not limited to) predictive analytics, applied machine learning, big data, data warehousing and data science.

Data

The data consisted of de-identified information covering ElderNet services between January 2019 and October 2021, including client demographics (e.g. county, poverty status, minority group, and age label), care management interactions (e.g. assistance date, communication type, benefits and assistance discussed per interaction), food pantry visits (e.g. visit date, type of assistance, quantity of food), and information on rides provided by ElderNet volunteers to clients (e.g. date of each ride taken and main reason for ride). Additionally, data on donations received by ElderNet (e.g. donor zip code, amount and campaign) was also included.

Data De-Identification Process

Datathon organizers helped de-identify the datasets after signing confidentiality agreements. Unique clients across all ElderNet services were compiled into a comprehensive list and given new, randomly generated client IDs. Each dataset was re-coded to use the newly generated client IDs, and any identifiable data was

removed: client race information was transformed to a minority flag (yes/no) and income information was reduced to a poverty flag (yes/no) using criteria not shared with datathon participants (but provided to ElderNet separately). ElderNet client's ages were transformed into age ranges, and random letters were assigned to these age ranges. These letters were the only age information provided to datathon participants (no translation to clients' real age range was provided to participants, but this was provided to ElderNet separately). Finally, clients' location information was reduced to county level (Montgomery or Other).

Preprocessing of Care Management data

The care management dataset was provided to datathon organizers as text entries. As part of data preprocessing, a set of categories of benefits and assistance types were defined. For a subset of the data (due to time constraints), each text line was hand coded into one of these categories. The category definitions are listed below:

Assistance types:

- **Coordination:** following up/connecting with client/service provider to facilitate something
- **Continuation:** helping client maintain their existing benefits
- **Enrollment:** helping with the enrollment process
- **Filing:** submitting forms (when enrollment/continuation of benefits unclear)
- **Information:** providing information, explaining documents
- **Referral:** referral to a provider, informing client of specific providers for their problem
- **Support:** in person/social visits, doing/bringing/buying things for the participant

Benefit types

- **ADL:** activities of daily living, Home health Aides
- **ElderNet:** processes to do with being an ElderNet participant
- **Financial:** pension, SSDI, SS, retirement, debt, taxes, etc
- **Food:** ability to access and obtain food
- **Housing:** to do with a person's home or living environment, including rent, mortgage, repairs, etc
- **Legal:** power of attorney, advance directives, ID & identity theft; voting
- **Medical:** physical and mental health care, health insurance (& waiver programs), rehab
- **Pets:** pet care, pet food
- **Safety:** emergency preparedness, firearm removal, hoarding, etc
- **Social:** social visit, questions about social activity, etc
- **Telecommunication:** access and use of phone service, internet, TV; things to do with technology
- **Transportation:** access to public transit, medical and nonmedical transportation, etc
- **Utilities:** electric, gas, water

Overall recommendations for data collection

For more efficient data processing options in the future, particularly with regard to Care Management data, we would recommend the following:

- Record interactions so that a record reflects only one interaction. For example, if an ElderNet employee speaks with a colleague and then follows up with the client based on that conversation, make sure those are two records; we saw instances these details were encompassed into the same note.
- Label interactions based on future analytics needs, so that all interactions can be categorized at the time of recording. The categories listed above were inferred from care manager notes, but these should be refined to more accurately capture the work. It is important to note here that too many categories can make recording more time-consuming, so this should be considered when defining a list of labels.
- To reduce the complexity of summarizing data, labels should be used consistently, and their wording or definitions should not change.

2022 Datathon (R Ladies Philly / Data Philly)

Team 1

4/13/2022

ElderNet's Impact in the Community

Executive Summary

ElderNet provides a lifeline to elderly and disabled residents of Lower Merion and Narberth Townships in Pennsylvania by connecting them with public services to help them remain independent and in their own homes for longer. This data review confirmed the need for such services by highlighting an potentially overlooked population in poverty in an otherwise high-income area, and documenting the continued use of services to meet basic human needs such as a food pantry and access to medical care. Our analysis demonstrates that ElderNet is doing well to reach a community in need and suggests the utilization of a metric to track client activity and connecting this with client outcomes to better determine the efficacy of offered services in keeping clients in their homes. Such a metric may also help to ensure service accessibility remains unobstructed in times of disruption and uncertainty such as during the COVID-19 pandemic.

Contributors

- Troy Bleacher
- Gabriel Butler
- Brendan Graham
- Katarina Gutierrez
- Kathrine McAulay
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Problem Definition

ElderNet of Lower Merion and Narberth is a nonprofit organization that was founded in 1976 by representatives of community, religious and governmental groups. ElderNet serves adults of all ages, especially frail older or younger disabled persons with low to moderate incomes who reside in Lower Merion or Narberth. ElderNet helps older neighbors remain independent and provides a variety of free, practical services so they have access to healthcare, food security, and an improved quality of life. ElderNet also provides information to individuals who need assistance with housing, nursing care, or other necessities.

The role of Team 1 in this Datathon was to explore the impact of ElderNet services on the community it serves.

Dataset

Data from ElderNet was deitentified and recoded by the Datathon leads and was provided to the teams as five distinct datasets. Clients were assigned unique identifier to allow comparison and merging across datasets.

- Care Management: A summary of the assistance received by each client and the associated benefit to that client
- Client Info: Basic demographics (County, poverty status, minority status, and a blinded age group assignment)
- Donations: A summary of ElderNet donation information; no client information
- Pantry: A summary of the food provided to each client via the Pantry service
- Volunteer Services: A summary of the rides provided to each client and the purpose of each ride

Some basic data cleaning was required for the Care Management dataset to correct for typos etc. A cleaned version of this dataset can be found here.

There were a large number of missing values in the assistance and benefit categories within the Care Management dataset. Further, these variables were split into three assistance and three benefit categories, to allow capture of multiple assistance events on a single date. To consolidate this information and minimize NA values, these variables were merged. The merged version of this dataset can be found here.

Results

How has ElderNet helped remain in their home for longer? Without outcome data for each client, it was not possible to infer which ElderNet services were associated with successfully allowing clients to remain in their homes. Instead, service usage was reviewed in aggregate to highlight those that were most heavily used.

Between February 2019 and August 2021 there were:

- 21,504 instances of direct care
- 766 home visits, lasting more than 485 hours
- Over 638 hours of phone calls
- 145,300 lbs of food issued from the Pantry
- 2,102 rides to doctor's appointments

The services offered by ElderNet were returned to time and again by clients, proving not only their utility, but their availability. 119 clients took advantage of services 50 or more times, and 66 used them 100 or more times.

The concept of tracking client activity over time was also explored and an *Active Client* was defined as a client who had used at least one service (volunteer services, pantry, or care management) in at least one of the previous two months. This is a lagging indicator and the impact of the COVID-19 pandemic can be seen in 2020, followed by a hopeful uptick in service usage following vaccination roll out in early 2021 (Figure 1). A limitation of this metric is that it does not take into account the intensity of service utilization; however, the inclusion criteria can be modified to narrow or widen the window as desired. See the Appendix for more details about how this metric was created.

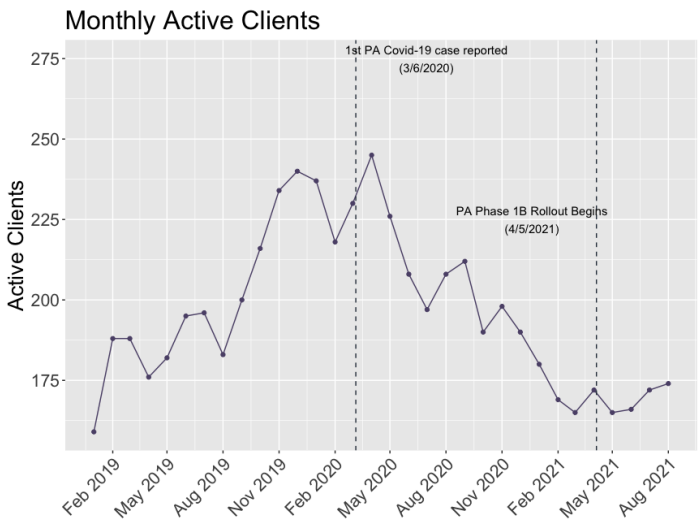


Figure 1. ElderNet client activity over a two year period

How well is ElderNet connecting participants to the public benefits that they need? Health/Medical: Between April 2015 and December 2021, ElderNet volunteers provided services to clients 4,100 times, and the largest share of these (2,102, 51%) were transportation to doctors appointments (Figure 2).

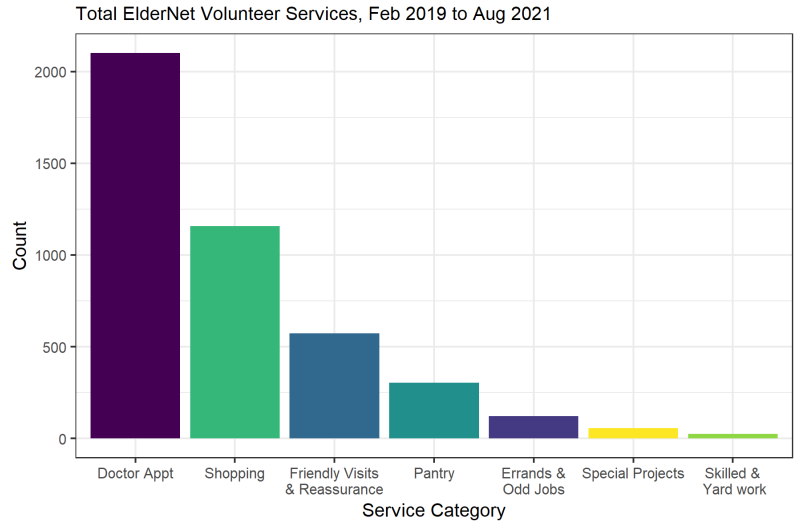


Figure 2. Needs met via ElderNet volunteer services, including transportation and home visits

Food Assistance: The second largest share of volunteer services went to shopping, impacting 76 clients a total of 1158 times. Further, the Pantry service has issued 145,000 lbs of food to clients since 2019, with peaks seen around the winter holidays, when ElderNet issues holiday baskets and also in the early months of the COVID-19 pandemic in 2020 (Figure 3, green line). It is not surprising that the pandemic impacted ElderNet services, with both Care Management and Volunteer Services seeing a decline in early 2020 (Figure 3). This can be explained in part by the lack of availability of public services such as doctors appointments. However, the apparent increase of Pantry usage during this time highlights the value of this service in the community in times of need.

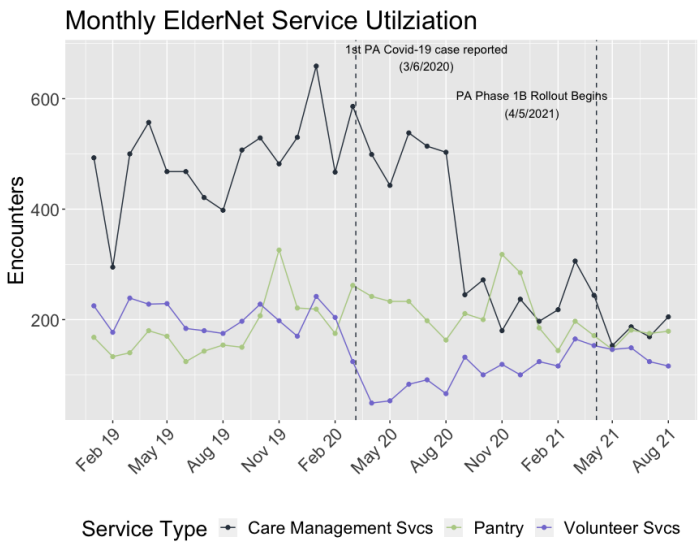


Figure 3. Utilization of ElderNet Care Management (black), Pantry (green), and Volunteer (purple) services between February 2019 and August 2021

How do the counties served by ElderNet compare to similar counties where services like ElderNet are not available? With Team 3 taking a deep dive into geography in the context of service expansion, Team 1 opted to limit analysis to Montgomery County, PA. ElderNet currently serves two Townships within the County: Lower Merion and Narberth. Only 6% of the 805,000 Montgomery County residents fall below the federal poverty level and the median income in Lower Merion is $140,000; this is the highest in the County (2016-2020 American Community Survey, US Census Bureau (Figure 4). Nonetheless, 490 people in this region required assistance associated with basic human needs such as food and accessing healthcare in the last two years. It is clear that if such a need exists in these Townships there is likely a similar or more pronounced need in neighboring Townships.

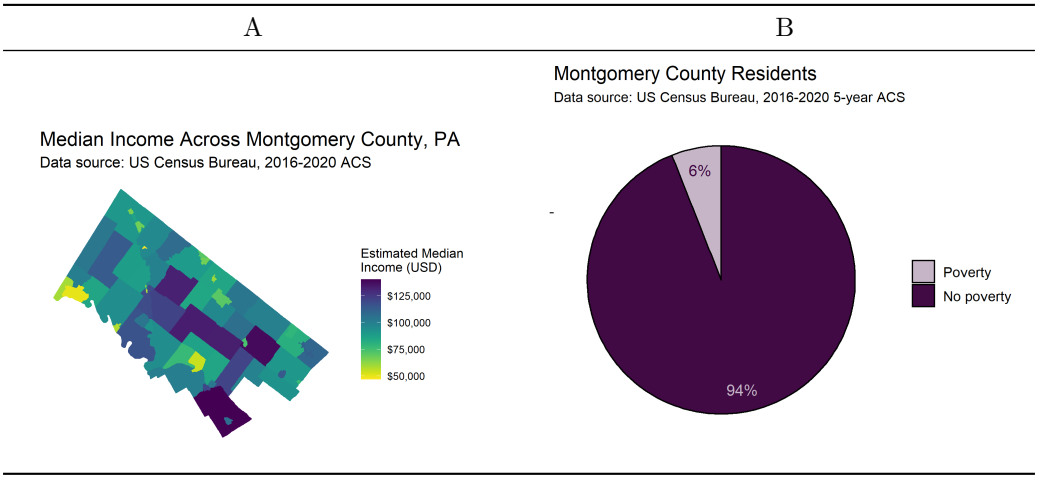


Figure 4. Proportion of residents below the federal poverty level in Montgomery County, PA (A) and the estimated median household income across the county (B). Lower Merion and Narberth are highlighed in the red box.

Conclusions

- Based on typical usage, transportation, especially to doctor's appointments, is an extremely desired service
- Access to the food pantry was a consistent and well used service
- The pandemic impacted monthly active clients, but active clients began to rise following vaccine roll out
- Linking this information to the current in-home status of clients would allow provide more insight into the effectiveness of these services

Remaining Questions

- What services were most likely to enable a client to stay in their home?
- Did client COVID-19 vaccination status impact ridership or other services?
- Was the drop in ridership during early pandemic due to reduced demand, or reduced availability of drivers?
- Did the rise in telemedicine impact need for rides to doctor's appointments, that is, what percentage of rides could be eliminated if patients were able to access telemedicine?

References

2016-2020 5 year American Community Survey, US Census Bureau

Census data was obtained and analyzed using the `tidycensus` R package, using resources from Kyle Walker: https://walker-data.com/tidycensus/

This data can also be accessed in a user-friendly API at https://data.census.gov/cedsci/

Appendix

Active Client Details Not every client has an interaction with *each* service *each* month. For example, a client may use volunteer services in January, then 2 months later visit the pantry leaving a gap in their utilization. To get a "tidy" dataset where we have 1 row per client per month, we created a 'master calendar' for each client, starting from the first date in the data set and ending at the last date. Then we adjust this for the date of each client's first interaction. Prepping the data this way will allow us to join the care management, pantry and volunteer data to the client data for each client for each month, which will preserve instances where a client had 0 interactions in a given month.

Once the data is prepped we can define a process to categorize a client as active or not. The process is as follows:

- for each client for each month, calculate the number of ElderNet services they engaged with. This number will range from a minimum of 0 if they didn't use any services, to a maximum of 3 if a client used the pantry, volunteer services and care mgmt services in that month.
- calculate a 2 month rolling mean of services each client engaged with
- check if that rolling mean is greater than or equal to 0.5, and if so define that client as being active in that month
- add up all active clients for each month

Both the rolling mean period and threshold can be adjusted to either widen or narrow the definition of an active client. To make the definition more strict, the threshold could be changed to from 0.5 to 1, which

would mean the client would need to use least 1 service offered in 2 of the 2 previous months. To make the definition more relaxed, the rolling mean period could be extended to 3 months and the threshold could be changed to 0.33, which would mean the client would need to use least 1 service offered in 1 of the 3 previous months to be considered active.

The table below shows how a single client can fall into or out of Active Client status depending on the rolling mean period and threshold used. the `lookback_mean_` columns contain 2 and 3 month rolling means of services used, respectively. The remaining `acitve_client` columns compare the rolling means to various thresholds

column	rolling mean used	threshold value used	interpretation
active_client_2_mo	lookback_mean_2m0	1.00	if rolling mean > threshold, used at least 1 svc offered (pantry, volunteer, care mgmt) in 2 of the 2 previous months
active_client_3_mo	lookback_mean_3mo	1.00	if rolling mean > threshold, used at least 1 svc offered (pantry, volunteer, care mgmt) in 3 of the 3 previous months
active_client_2_mo_relaxed	lookback_mean_2mo	0.50	if rolling mean > threshold, used at least 1 svc offered (pantry, volunteer, care mgmt) in 1 of the 2 previous months
active_client_3_mo_relaxed	lookback_mean_3mo	0.67	if rolling mean > threshold, used at least 1 svc offered (pantry, volunteer, care mgmt) in 2 of the 3 previous months
active_client_3_mo_extra_relaxed	lookback_mean_3mo	0.33	if rolling mean > threshold, used at least 1 svc offered (pantry, volunteer, care mgmt) in 1 of the 3 previous months

An example (client number 641):

month ↑	anon_ID	num_svcs_used	lookback_mean_2mo	lookback_mean_3mo	active_client_2mo	active_client_3mo	active_client_2mo_relaxed	active_client_3mo_relaxed	active_client_3mo_extra_relaxed
2020-01-01	641	1	1	1	1	1	1	1	1
2020-02-01	641	2	1.5	1.33	1	1	1	1	1
2020-03-01	641	1	1.5	1.33	1	1	1	1	1
2020-04-01	641	0	0.5	1	0	1	1	1	1
2020-05-01	641	0	0	0.33	0	0	0	0	1
2020-06-01	641	1	0.5	0.33	0	0	1	0	1
2020-07-01	641	0	0.5	0.33	0	0	1	0	1
2020-08-01	641	0	0	0.33	0	0	0	0	1
2020-09-01	641	1	0.5	0.33	0	0	1	0	1
2020-10-01	641	0	0.5	0.33	0	0	1	0	1
2020-11-01	641	0	0	0.33	0	0	0	0	1
2020-12-01	641	0	0	0	0	0	0	0	0

ElderNet Interactive Dashboard

2022 Datathon for ElderNet

Team 2

April 11, 2022

Contents

Executive Summary

As a non-profit organization providing vital services and assistance to the elderly, ElderNet needs to make strategic decisions often spanning multiple layers of operation. We sought to create a series of interactive dashboards that would help inform Eldernet's decision-making pipeline and serve as a storytelling tool. Our dashboards were built in Power BI and Tableau, both platforms chosen to ensure Eldernet could recreate and maintain these visualizations with relative ease and minimal effort, whether it is in a public-facing website or as part of their internal documentation.

Contributors

Paromita Barua, MS is a Technology consultant at IQVIA who also completed her Masters in Business Analytics with a minor in Applied Data Science at Drexel University in 2021. She enjoys hands-on data analysis and is interested in expanding her skills in data science and R/Python programming.

Sean Cancino, MS is an aspiring data scientist who completed a Masters in Statistics at the University of Delaware in 2021. He also received a Bachelors in Neuroscience from the University of Delaware in 2015. He is currently interested in learning new data science methods and data engineering techniques. In his free time, he enjoys running, hiking, exploring new events and trying out new restaurants in the city.

Michelle Chiu, MA is a PhD Candidate in Psychology at Temple University studying the potential impact of digital media engagement in cognition and behavior. She also works as a statistics consultant for Temple's Executive Doctorate in Business Administration program. When she's not tackling and visualizing data using R, you can find her exploring Philly's food scene or practicing yoga.

Cynthia Cho, MBA currently has an MBA in Data Project Management from Keller Graduate School of Management. She graduated in May 2013. She was a former Data Elements Planner at IQVIA and is currently pursuing a Machine Learning Certification from Open Data Science Conference. She enjoys hands-on data analysis in SQLite and is expanding her skills in Data Science and Python programming.

Problem definition and dataset

Prior to the analysis, the team had joined together data tables provided by ElderNet from the Github repository provided and joined the related data in Python into a single dataset. Our team examined many factors and variables from many key areas which influence Eldernet client satisfaction and Eldernet's strength. Among these are in the area of Financial Assistance, Care Management, and User Engagement. While we researched these key factors for which we also analyzed the data and created visualization dashboards which illustrated these ideas.

Data Challenges

- Missing (NA) values across multiple variables of interest, including donor zip codes and client demographics.
- Little to no overlap in identifier variables between data sets.Moreover, the donations data set could not be merged to any of the other data sets provided.

Our team included the NA values when describing client demographics (e.g. socioeconomic status, minority) since it was not clear whether these data were missing at random or due to clients choosing to not respond.

We created three dashboards to provide a comprehensive overview of the data for ElderNet.

Results

Dashboard 1. Financials

We sought to provide a dashboard (interactive link here) that would allow ElderNet to both visualize their overall financial status across four facets of the donations data, as well as flexibly draw comparisons that might help maximize funding and campaign efforts.The dataset used in this analysis was *donations_anonymized.csv*.

Figure 1 illustrates donations from across all 20 campaign types. Users can select single or multiple Campaign Types via check box or keyword search. As you'll see in the example below, donations data can be adjusted across all four panels according to the Campaign Type/s selected.

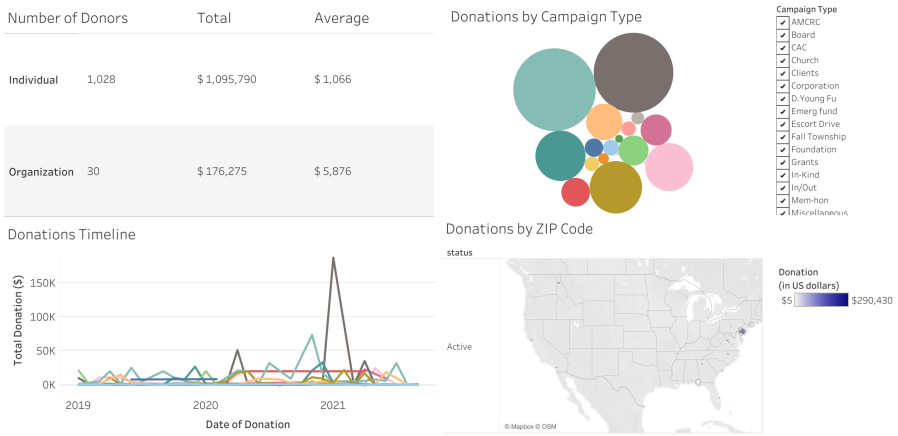
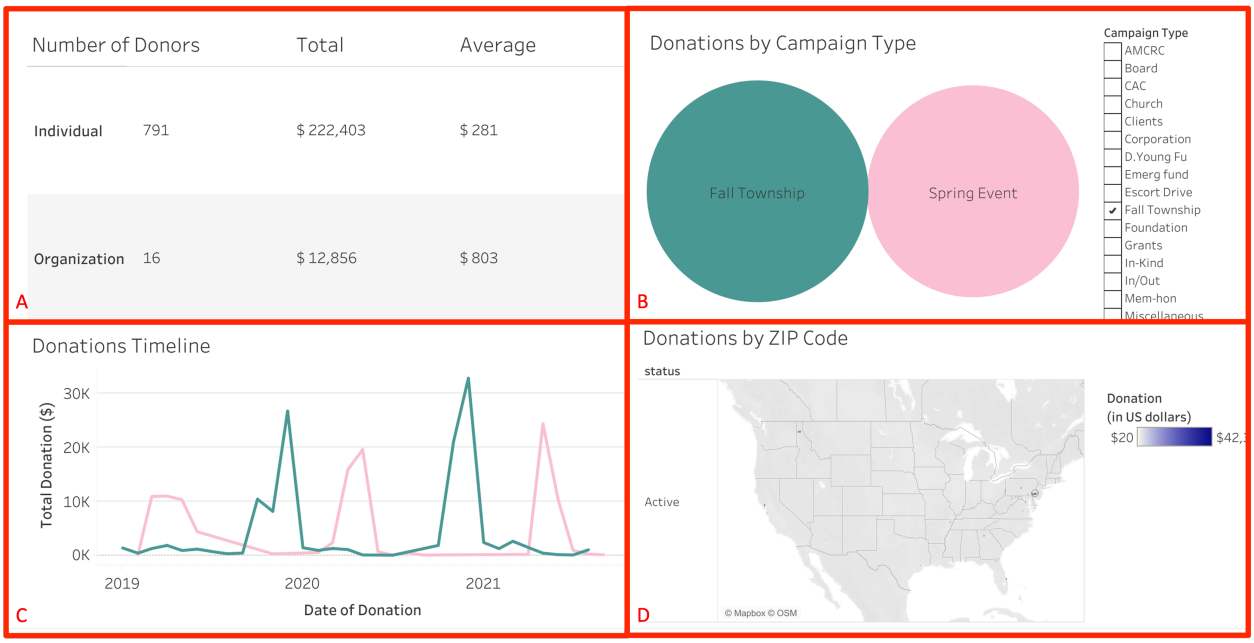


Figure 1: ElderNet donations across all campaign types between January 2019 and September 2021.



The image above shows donations specifically from **Fall Township** and **Spring Event** campaigns.

- Panel A shows that a majority of overall donations came from Individuals, rather than Organizations.
- Panel B shows that patrons donated relatively similar amounts to both campaigns.
- Panel C suggests an overall upward trend in donations between late 2019 to 2021, with donations peaking seasonally in a way that corresponded to their respective campaigns (e.g. peak donations for Fall Township occurred in what is considered Fall/Autumn in the continental US).
- Finally, Panel D provides a map highlighting the areas corresponding to donor zip codes – in this case, we see that most of the donors came from the surrounding area of Philadelphia, though some donors also came from non-East Coast regions.
- Users can also interact with specific panels; for example, in Panel D, users can zoom in on the East Coast region and see how donations varied in the surrounding Philadelphia area.
- Lastly, users can hover their mouse over specific parts of each panel to see their respective data (e.g. hovering over one of the bubbles in Panel B would display the corresponding campaign type and amount donated.

Dashboard 2. Care Management

The Care Management dashboard (linked here) displays how clients have been interacting with ElderNet, as well as the types of assistance and benefits that they request from ElderNet.

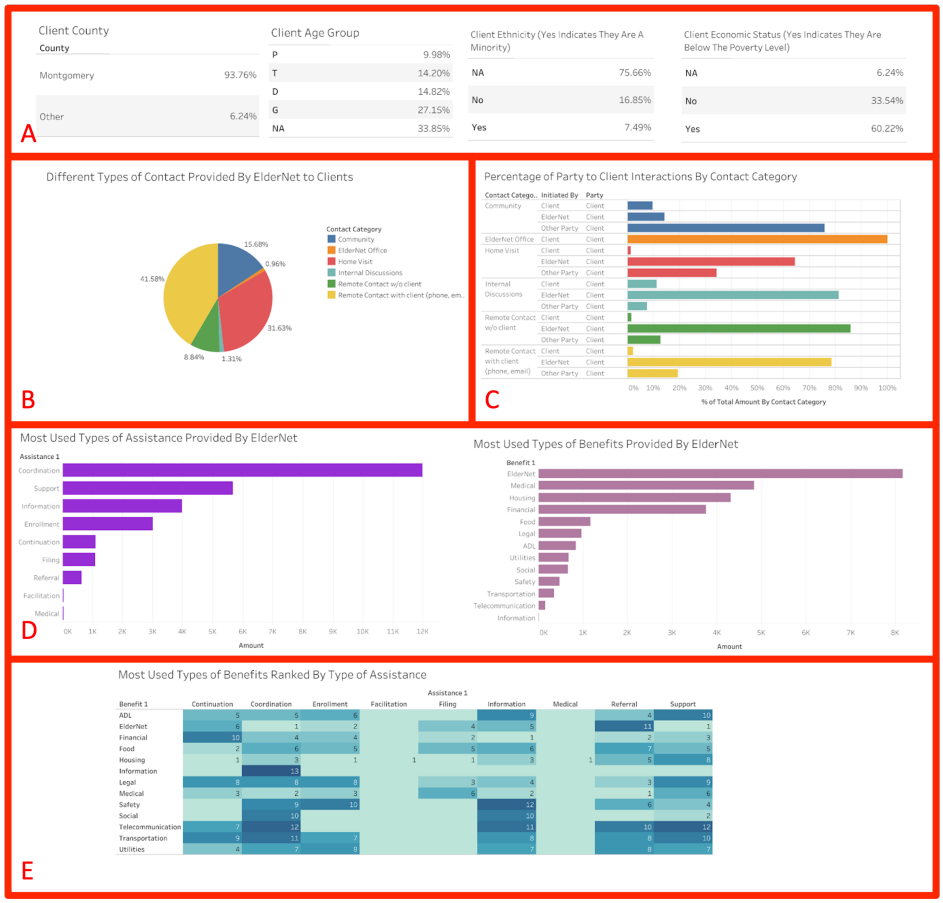


Figure 2: Client interactions with ElderNet between 2019 and 2021.

- Panel A shows the types of contact ElderNet has had with their clients as percentages of all contact ElderNet has had with their clients. ElderNet has around 50% remote contact with their clients, and also has around 33% contact as in person home visits with their clients.
- Panel B shows the percentage of contact ElderNet, other parties, and other clients have with ElderNet's clients for every contact type. ElderNet interacts with their clients the most compared to other parties in the contact categories "Home Visit", "Internal Discussions", and "Remote Contact With and Without Client". Other parties communicate with clients the most in the contact category "Community".
- Panel C shows the types of assistance and benefits of clients that are the most inquired about and used when they contact ElderNet. Coordination, support, information, and enrollment seem to be the most used types of assistance that ElderNet provides to clients. Other than ElderNet, medical, housing, food, and legal benefits seem to be the most used types of benefits that ElderNet provides to clients.
- Panel D shows the benefits that clients inquire about the most relative to the type of assistance provided by ElderNet. The most used benefits are ranked by each type of assistance. In order to interpret this table, pick an assistance category such as enrollment. To see the ranking of the most used benefits with respect to enrollment assistance type, find the enrollment column in the table. The numbers under that column indicate the ranking of the most used benefits with respect to Enrollment. The most used types of benefits with respect to enrollment are housing, ElderNet, legal, and financial.

Dashboard 3. Client Engagement

Our goal was to visualize how clients utilize the services offered by ElderNet. The 3 datasets used in this analysis were: *client_info_anonymized.csv*, *volunteer_services_anonymized.csv*, and *pantry_anonymized.csv*.

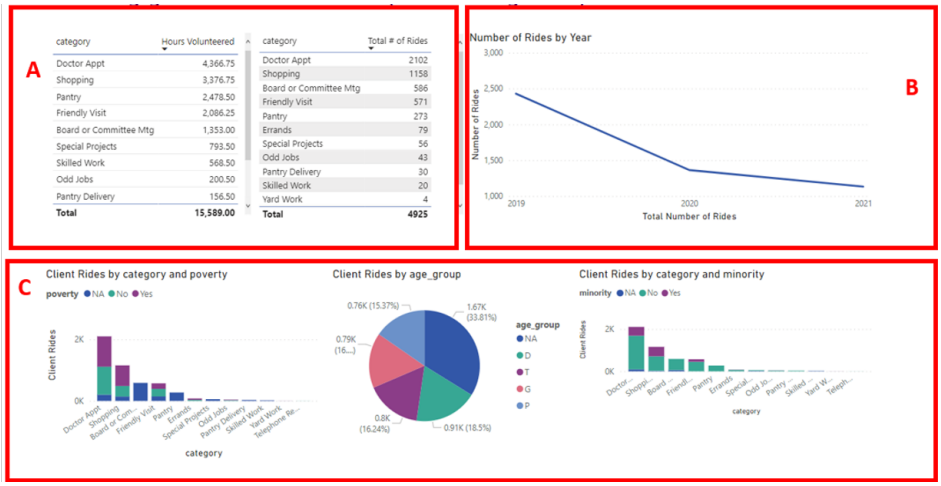


Figure 3: Volunteer services (rides involvingn clients) betwene January 2019 and September 2021,

The dashboard above contains data for volunteer services, particularly rider services collected from January 2019 to September 2021.

- Panel A highlights categories which had the highest total hours volunteered and total number of rides provided.
- Panel B provides an overview of how the number of rides changed from 2019 to 2021.
- Panel C displays how different categories tie in with client demographics. For example, we can deduce from the Client Rides by age_group visual that the highest number of rides were taken by age group D.

Figure 4: Food Pantry Interactions

The dashboard above (linked here) contains data for Pantry utilization collected from January 2019 to September 2021.

- Panel A highlights assistance category with highest number of pantry requests.
- Panel B provides an overview of how much food, boxes/bags and dollars changed from 2019 to 2021.
- Panel C displays how pantry requests look across different client demographics. For example, pantry services are used mostly by impoverished and minority clients. Additionally age group G clients are more likely to seek pantry services.

Overall, we believe that the client management dashboard can be leveraged to understand which services are most valuable to a given client based on certain demographic trends.

Next Steps

Should ElderNet want to create these visualizations in either Tableau or PowerBI, they can review cost, pros and cons for each platform below.

Tableau

Cost

- $74 per user/month for Desktop and Tableau Prep Builder
- License donations for nonprofits

Pros

- Easy UI to learn and create visualizations
- Can handle large data using the cloud environment
- Effective data visualization tool for Mac and mobile audiences

Cons

- Less flexibility for tracking/managing diff versions
- Slightly difficult to import custom visualization
- Embedding reports requires Tableau Public

Power BI

Cost

- $3 per user/month for Power BI Pro
- Nonprofits options with training & support

Pros

- Can integrate with Microsoft cloud platforms and other platforms
- Provides tools such as Power Query for ETL processing
- Is capable of embedding reports; step-by-step guide linked here

Cons

- Not user-friendly for Mac users
- UI is not that intuitive compared to other visualization tools
- Importing large data sets (greater than 1 GB) not possible with Pro version

ElderNet of Lower Merion and Narberth
Team 3
3/30/2022

Contributors

We would like to thank the other teams for their valuable help in understanding and cleaning the data. We would also like to thank the R-Ladies and DataPhilly organizers for leading this event. Finally, our sincere thanks to ElderNet for providing their data and guidance throughout the project.

- Michael Bryan
- Lasaly Changkachith
- Cara Cuiule
- Zane Dax
- Jamaal Green
- Michael Holt
- Alisha Paul
- Dave Slinger

Executive Summary

The results in this report reflect functional observations and visualization. The granularity and quality of the data shared do not support statistical inference, so the results here should be treated as suggestions and worth future effort.

Observations:

- Geography matters. ElderNet's service delivery and donations are local to ElderNet's office in Bryn Mawr. Demographic data can contribute to a location model. Such a model on current service areas would assess wider geographies for potential need.
- Median Household Income, Population of 55+ and Population with Disabilities are appropriate measures for a location model.
- Philadelphia, Quakertown (18951), Pottstown (19464) and Coatesville (19320) areas have potential as future locations.
- Small donations add up. 50% of donations are made from amounts less than $10,000.
- Donations had a lot of variation and are very difficult to forecast, currently reflecting 1 sample pre-pandemic and the 2 pandemic years.
- Donations are related to median household income from Census data sources. This relationship is modest.
- Eldernet's donation data, making it difficult to forecast.
- Some data relationships are likely to change due to the pandemic. It has affected data collection including the national census. Donations, care management, volunteer services and other personal interactions were affected. The isolation and economic impact on the elderly is yet to be measured. These factors also complicate forecasting.
- Publications by federal, state and county level include surveys, budgets and counts of social services delivered. While their data is limited, these sources provide trends and service definitions against which Eldernet can compare its own offerings.

- Comparing ElderNet's services to public services suggests the potential for ElderNet service growth.
    - Homebound services including meals and caregiving.
    - Activity services like Senior Centers & Adult Day Care.
    - Health services for wellness, Medicare and prescriptions.
    - Financial support with taxes, insurance and social security.
-

Prompts

This study pursued the following prompts from ElderNet, recommending actions for its future and general growth interest:

1. Are there areas of need that ElderNet should focus on in the future? (e.g. you can use Census data to provide an in-depth picture by county/ZIP Code of the population, and their likely needs)
2. Explore ElderNet's growth with regard to number of clients, donors/donation amount, etc.
3. Any other analyses you think would be interesting to do/helpful to ElderNet to better understand their data

Data

The following material may be duplicative with other teams, but necessary here to allow this report to stand alone. Each of these assets have applications in the prompt sections below..

ElderNet's Anonymized Client, Service and Donations Data

ElderNet initiated this study offering data files on clients, services and donations which were anonymized to protect client identities. These files included:

- ***client_info_anonymized.csv*** includes basic de-identified demographics on clients.
- ***care_management_anonymized.csv*** provides information on clients' interactions with ElderNet Social Workers.
- ***volunteer_services_anonymized.csv*** offers information on rides provided by ElderNet volunteers
- ***pantry_anonymized.csv*** collects a history of clients' visits to ElderNet's food pantry
- ***donations_anonymized.csv*** shows donations made in support of ElderNet's activities

ElderNet's Client Counts by Service and ZIP Code

Subsequent to the study's initiation, ElderNet summarized client counts by ZIP Code to support geographic modeling. The file named ***aggregated_numbers.md*** shows the number of clients engaging Eldernet by service and by ZIP Code.

U.S. Census Bureau Sources

The US Census Bureau publishes its major Decennial estimates every decade. This is required by the U.S. Constitution for apportioning seats in the House of Representatives. With each Decennial, the Census also updates the delineation of Census geographies including Tracts, Block Groups and Blocks. These geographies are contained with counties and states. The publication of geographic shapes is called the TIGER/Line.

- On a rolling basis, the Census publishes the American Community Survey (ACS) with 1 Year and 5 Year estimates. The most recent 2019 vintage of the ACS 5 Year estimates was used in this analysis.
- Consolidating data by ZIP Code is expeditious, but these geographies do not directly support demographic data. The US Postal Service defines ZIP Codes to manage efficient routes for mail carriers which can span counties. The Census Bureau converts ZIP geographies to ZIP Code Tabulation Areas (ZCTA) for demographic data publications.

Other Sources from Federal, State and County Agencies

Additional public reporting was found by simple internet searches from the following agencies:

- U.S. Department of Health & Human Services, Department on Aging
- National Institutes of Health, National Institutes on Aging programs
- Pennsylvania Department on Aging
- Montgomery County Office of Senior Services

Applied Technologies

The study's presentation and final report relied on these technologies:

- R and R Studio using pacman, mapsf, tidycensus, simplefeatures, tigris, tidyverse
- Python and Jupyter using pandas, geopandas, matplotlib, seaborn, plotly
- QGIS is a desktop GIS tool
- Streamlit is used for interactive mapping

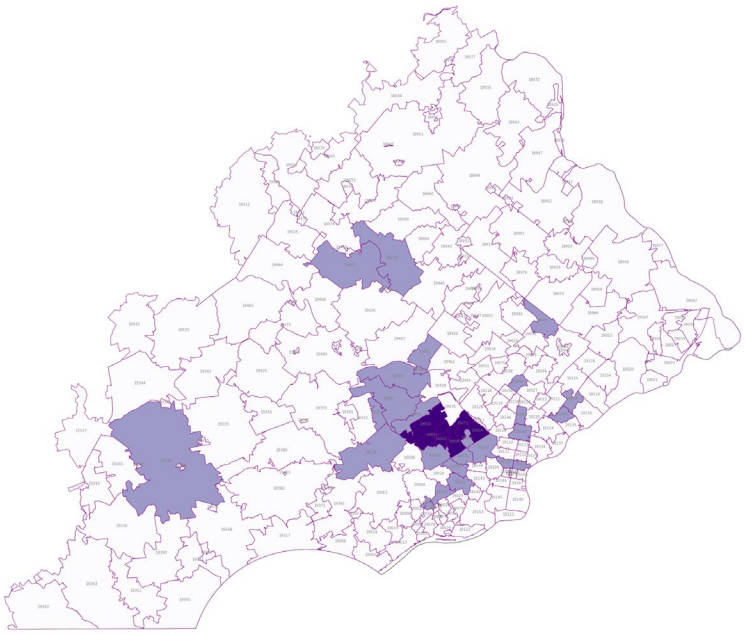
Results

Prompt 1: Future Focus

Insight from Census Data

ElderNet's current service delivery reflects the locality of its office in Bryn Mawr, PA. Both client counts and donation volumes are highest near the office and dissipate with distance from Lower Merion. It is appropriate to apply location model concepts, where future areas' service would be predicted by current service delivery related to demographic data. The figures below visualizes this location based business with darker Zip Codes having the majority of services activity.

ElderNet's Client Counts by Zip Code:



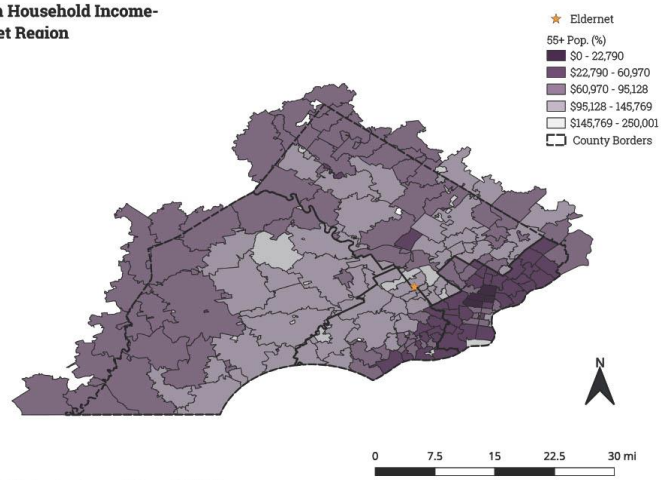
The Team attempted to build such a model statistically. This effort began by casting ElderNet's service counts by Zip Code on to Census geographies called Zip Code Tabulation Areas (ZCTAs). The effort then defined ElderNet's current service area to include ZCTAs adjacent to those currently served. A predictive model on this service area definition would be applied to wider areas to assess their potential for service needs. It would also be applied to estimate need for each regional county, valuable for justifying ElderNet's public funding.

Logically, the model effort sought a subset of the 2019 ACS dataset's 36,000 variables including total population, population over 55 years of age, population with disabilities and median household income. Analytically, the logistic regression algorithm was applied. The training effort did not find strongly significant relationships of any of these variables and ElderNet's service variability. The lack of significance suggests that some basic assumption is incorrect. Either ElderNet is not serving these populations or that its level of service does not reflect each geography's need. The latter conclusion is most reasonable.

Geographic Growth

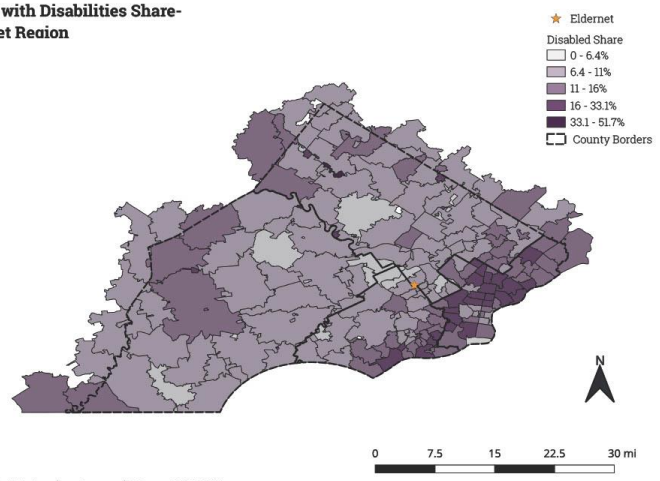
As a result, ElderNet should still pursue these predictive variables in their growth planning. From the Census ACS 5 year data, Total population, Median Household Income, Population over 55 and Population share with disabilities are the primary demographic metrics for evaluating an area's potential for service.

Median Household Income- Eldernet Region



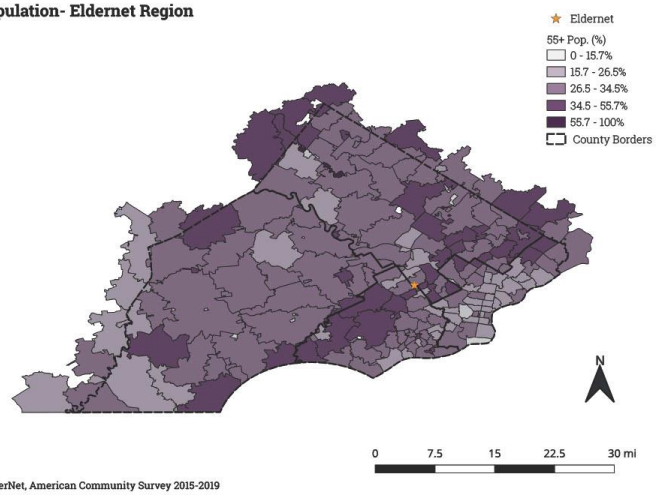
Source: ElderNet, American Community Survey 2015-2019

People with Disabilities Share- Eldernet Region



Source: ElderNet, American Community Survey 2015-2019

55+ Population- Eldernet Region



Source: ElderNet, American Community Survey 2015-2019

By observation of the maps provided above, the city of Philadelphia shows concentrations of need in every variable. West Philadelphia in particular has both need as well as proximity to ElderNet's office. Philadelphia also has its own budget including funds directly from federal sources. Unless there are known constraints, the city would be a logical growth location.

Outside the city there are ZIP Codes with both low income and population density that should be assessed as potential next locations for Eldernet. These would include

- Eastern Delaware County including Darby (19023)
- Central Montgomery County including Norristown (19404)
- Western Montgomery County including Pottstown (19464)
- Central Chester County including Coatesville (19320)

Other Public Data Sources

In addition to the Census, ElderNet can take advantage of public datasets now required by their original funding and the Open Government Data Act (2018). These data projects have national scope with a sampled survey basis. As a result, they do not have the detail to support data appending at the ZIP Code or client address level as the ACS does. With their reports, they can be used to anticipate changes in aging needs as well as service definitions. Most consistently these publications forecast that elderly population is growing faster than the total population as Baby Boomer age and healthcare extends life expectancy. They include:

- The National Survey of Older Americans Act Participants (NSOAAP) published by the Aging, Independence, and Disability (AGID) Program within Administration for Community Living (ACL). https://agid.acl.gov/
- Research publications sponsored by the NIH's National Institute on Aging:
    - National Archive of Computerized Data on Aging (NACDA) from the University of Michigan
    - National Social Life, Health, and Aging Project (NSHAP) survey from the University of Chicago
    - National Health and Aging Trends Study (NHATS) also run by the University of Chicago as well as its supplement National Study of Caregiving (NSOC)
- The Commonwealth of Pennsylvania and local counties deliver services for aging adults and seniors funded by both local taxes as well as block grants from the federal programs.. The data from this public level is limited to budget and service counts.
    - Pennsylvania Department on Aging provides reports https://www.aging.pa.gov/publications
      Montgomery County' Office of Senior Services includes statistics in its 4 Year Plan which are taken from the Census ACS 5 Year estimates discussed above.
      https://www.montcopa.org/DocumentCenter/View/29022/OSS-4-year-Plan
- Public Health Management Corporation (PHMC) is a regional non-profit that serves the Philadelphia area and publishes the Community Health Data Base (CHDB). Access to this database requires registration and subscription fees. https://research.phmc.org/products/community-health-database

Prompt 2: Growth

Donation Forecasting

ElderNet's donation data demonstrates a high degree of variation, combining regular small donations with those from the fall campaign and major one time contributions. These impacts cause advanced forecasting methods to lose statistical significance. A simple forecasting method, using averages and ranges, makes these impacts clear in the trend figures in Appendix 17.

The data demonstrate seasonal or cyclical patterns. The top donation yielding campaign drives by dollar amount were the Foundation, the Emergency Fund, and the Fall Township drives. Nearly 50% of money donated came from donations below $10,000. 70% of money donated came from donations below $25,000.

Using the ACS data discussed above, ElderNet's donations show a significant correlation with local median household incomes. This suggests that donation campaigns may target affluent households, neighborhoods and high income corporations. This conclusion is probably shared by many non-profit organizations. Targeting would benefit, then, from other third party data sources that compile donor data by issues of interest.

Other Data Forecasting Observations

The other datasets provided by ElderNet provided the following observations (see Appendix 17 for graphs):

- **Volunteer Services** - Volunteer services dipped during pandemic, which makes sense as volunteer services were canceled/reduced for a significant period of time.
- **Care Management** - Care management generally decreased after the fall of 2020. Remote contact with and without the client were the two dominant categories within the dataset.
- **Pantry** - Pantry activity generally rises during holidays and also rose during the pandemic.

Suggestions for Future Data Collection

Predictive modeling would likely need more variables against local geographies over time not available to this effort. Some studies have investigated donations to non-profit organizations against variables such as income levels, age, years of education, religious participation levels, marital status, and income. See Ficklin (2014) as well as Meyer (2008). Possible variables that predict food insecurity in older adults are depression, financial issues, and past food stamp usage (Goldberg and Mawn 2014).

Growth in Range of Services Provided

Growing ElderNet services benefits from comparisons to public reporting on social services. These public reports first provide a basis of standardizing terms for each service. Aligning

ElderNet's service categories to these public definitions would help in communicating and coordinating public interactions including funding requests.

ElderNet's services overlap with those provided by federal and county human services organizations as well as third parties with public funding. The catalogs of these existing services can be found in the Appendix.

- Pennsylvania's Department of Aging funds county programs
- Counties then provide local social work. Montgomery County in particular delivers social services for Office of Senior Services https://www.montcopa.org/148/Senior-Services
- Catholic Social Services is contracted by the city of Philadelphia to provide a variety of programs for seniors. Funded by the city budget, it has public annual reports on services programs and the demand for each. https://cssphiladelphia.org/service-category/senior-services/
- PA 211 is another example of service for basic needs now contracted by Pennsylvania to the United Way. https://www.pa211.org/

Comparing ElderNet's services to these public services suggests the following potential for ElderNet service growth:

- Provide or integrate with other, public services that meet basic needs. This would include food, housing, healthcare access and safety from abuse. ElderNet probably already does this, so it may translate to increasing the granularity of reporting in Care Management.
- Expand services to the homebound from transportation to meals, caregiving and caregiver support.
- Add activity services such as Senior Centers and Adult Day Care with dedicated vehicles and facilities.
- Include health services focused on wellness, Medicare (like MEDI) and prescription assistance (like PACE).
- Financial support services including state and federal tax, insurance, social security income and planning.

Prompt 3: Other Analyses

Over the course of this study, several unrelated observations were found which may be valuable:

- While ElderNet serves Lower Merion primarily, it has clients in Chester, Delaware and Philadelphia counties. Each of these areas has potential for public funding and the geographic constraints that come with it.
- Care Management services and Pantry services appear correlated. There may be a functional reason that they rely on each other.
- First time rides peaked in 2015, and have been decreasing since then.
- Pantry services occurred more often before noon than after. This was not the case with rideshare services.
- As ElderNet develops a geographic view of donations, clients and services, interactive maps will be valuable.

- ElderNet maintains social media on Facebook today. It may benefit from sharing that same content to Instagram and Twitter to promote donations and volunteerism.

Conclusions and Next Steps

The study material above suggests that Eldernet should consider:

- advancing its analytical maturity by investing in granularity and quality in its data capture.
- extending client data by using geocoding to relate client addresses to smaller Census geographies such as block groups.
- developing a location model to assess geographies for growth potential against population, median household income, proportion over 55 and proportion with disabilities.
- new locations in Philadelphia, Darby (19023), Norristown (19404), Pottstown (19464) and Coatesville (19320).
- defining their service categories and terminology consistently with those used by the Department of Health and Human Services and Pennsylvania's Department of Aging.
- expanding their service offering to include:
    - Homebound services including meals and caregiving.
    - Activity services like Senior Centers & Adult Day Care.
    - Health services for wellness, Medicare and prescriptions.
    - Financial support with taxes, insurance and social security.
- targeting affluent households and geographies for fundraising with supplemental data from third parties and larger non-profit publications.
- using interactive map software to assess service activity geographically.

References

U.S. Bureau of the Census, American Community Survey, 2019 American Community Survey 5-Year Estimates, Base Tables; generated by Jamaal Green; using the R library tidycensus API.

U.S. Bureau of the Census, TIGER/Line Shapefiles, 2019, using the R library tidycensus API and ftp files. https://www2.census.gov/geo/tiger/TIGER2019/ZCTA5/tl_2019_us_zcta510.zip

Ficklin, Elizabeth, "Charitable Donations: An Analysis Of The Differences In Donation Patterns By Income Level" (2014). All Theses. 2056. https://tigerprints.clemson.edu/all_theses/2056

Goldberg, Shari L. and Mawn, Barbara E., "Predictors of Food Insecurity among Older Adults in the United States" (2014). Public Health Nursing. https://ogg.osu.edu/media/documents/sage/Goldberg%20et%20al%20week%206.pdf

Meyer, Lauren, "Predicting Charitable Contributions", University of Wisconsin - Madison, School of Business, Research Department, Spring 2008, https://instruction.bus.wisc.edu/jfrees/jfreesbooks/Regression%20Modeling/BookWebDec2010/Writing/CharitableContributionsMeyer.pdf

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Appendix

Appendix 1: ElderNet clients by service and ZIP Code.

- ZIP Code 10130 reflects Manhattan. Its data will be treated as 19130 center city.
- ZIP Code 19005 does not exist, so its counts will be excluded.
- ZIP Code 19450 is used for PO Boxes. Its data will be treated as 19438 instead.
- NA ZIP Code counts reflect clients without addresses including the homeless served. It will be excluded from geographic models.
- Where counts are less than 10, a value of 5 is assumed.

ZIP	Total	Care Management	Pantry	Volunteer Services
10130	5	0	5	0
19003	228	188	178	61
19004	29	26	16	5
19005	5	5	0	0
19010	129	87	98	25
19018	5	87	5	0
19040	5	5	5	0
19041	19	15	12	5
19050	5	5	5	0
19066	5	5	5	5
19070	5	5	5	0
19072	41	31	14	16
19073	5	31	5	0
19082	5	5	5	0
19083	5	5	5	0
19085	5	5	0	5
19087	5	5	5	0
19095	5	5	5	0
19096	79	67	19	34
19123	5	5	5	0

ZIP	Total	Care Management	Pantry	Volunteer Services
19131	5	5	5	0
19140	5	5	5	0
19141	5	5	5	0
19149	5	5	5	0
19151	5	5	5	0
19152	5	5	5	0
19320	5	5	0	0
19333	5	5	5	0
19401	5	5	5	0
19405	5	5	5	0
19406	5	5	5	0
19450	5	5	0	0
19473	5	5	0	0
NA	59	41	37	5

Appendix 2: Pennsylvania Aging Program Directives

https://www.aging.pa.gov/publications/aging-program-directives/Pages/default.aspx

Program Area	Service
01	AREA AGENCY ON AGING ADMINISTRATION
02	HOME-DELIVERED MEALS
03	CONGREGATE MEALS
04	SOCIALIZATION, RECREATION, EDUCATION & HEALTH PROMOTION
05	EMPLOYMENT SERVICES
06	VOLUNTEER SERVICES
07	PASSENGER TRANSPORTATION
09	LEGAL ASSISTANCE
11	INFORMATION AND REFERRAL
12	HOME HEALTH
13	PERSONAL CARE
14	PERSONAL ASSISTANCE SERVICES
18	MEDICAL EQUIPMENT, SUPPLIES & ADAPTIVE DEVICES
19	HOME SUPPORT
20	ADULT DAY SERVICES

23	CARE MANAGEMENT
24	PROTECTIVE SERVICES INTAKE AND INVESTIGATION
25	DOMICILIARY CARE
29	OTHER

Appendix 3: Pennsylvania Department of Aging Services

https://www.aging.pa.gov/aging-services/Pages/default.aspx

Caregiver Support

Employment

Health & Wellness

Help at Home

Housing

Medicare Counseling

Legal Assistance

Meals

Ombudsman

PACE - Prescription Assistance

Protective Services

Transportation

Appendix 4: Montgomery County Adult and Senior Services

https://www.montcopa.org/2889/Adults-Seniors

ADULTS AND SENIORS	SENIOR SPECIFIC
Basic Needs	Protective Services
Community Health Programs	Adult Day Cares
Drugs and Alcohol	Advocacy/Ombudsman
Health and Wellness	Family Caregiver Support Program
Homeowners	Home Delivered Meals
Intellectual Disabilities/Autism	Long-Term Care Facility List
LGBTQ	OPTIONs Program
Mental Health	Senior Centers
Veterans	Volunteer Program

Appendix 5: AGID Service Categories

U.S. Department of Health & Human Services, Aging, Independence, and Disability (AGID) Program
https://agid.acl.gov/DataFiles/NPS/

CATEGORY	SERVICE
Access Services	Case Management
	Transportation
Community Services	Congregate Meals
In-Home Services	Home Delivered Meals
	Homemaker
Caregiver Services	Caregiver

Appendix 6: Comparing ElderNet services to a public catalog

ElderNet Services

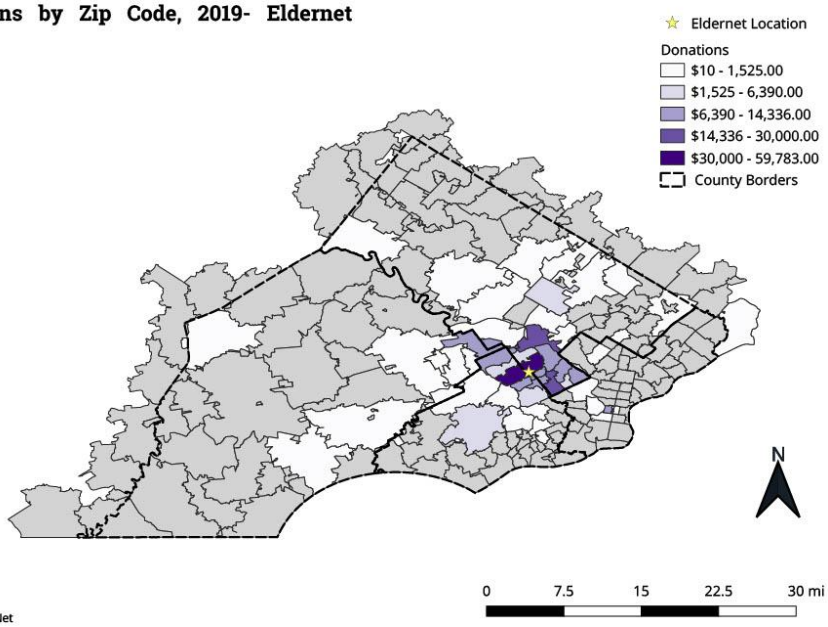
Service	Category	Activity
Care Management	Community	757
	ElderNet Office	47
	Home Visit	766
	Internal Discussions	233
	Remote Contact	1948
Volunteer Services	Meetings	586
	Doctor Appt	2102
	Errands	79
	Friendly Visit	571
	Odd Jobs	43
	Pantry	273
	Pantry Delivery	30
	Shopping	1158
	Skilled Work	20
	Special Projects	56
	Telephone Reassurance	3
	Yard Work	4
Pantry	Easter Outreach	19
	Food Pantry Poundage	5817
	Holiday Baskets	437

Pennsylvania Department of Aging

	Directives
✓	**Care Management**
✓	**Volunteer Services**
✓	**Passenger Transportation**
✓	**Food Banks**
o	Home-Delivered and Congregate Meals
o	Socialization, Recreation, Education & Health
o	Adult Day Services
o	Employment Services
o	Legal Assistance
o	Medicare Consulting
✓	**Information And Referral**
o	Home Health
o	Personal Care
o	Domiciliary Care
✓	**Personal Assistance Services**
o	Medical Equipment Home Support
o	Protective Services Intake & Investigation
o	Prescription Assistance

Appendix 7: Donations 2019 Map

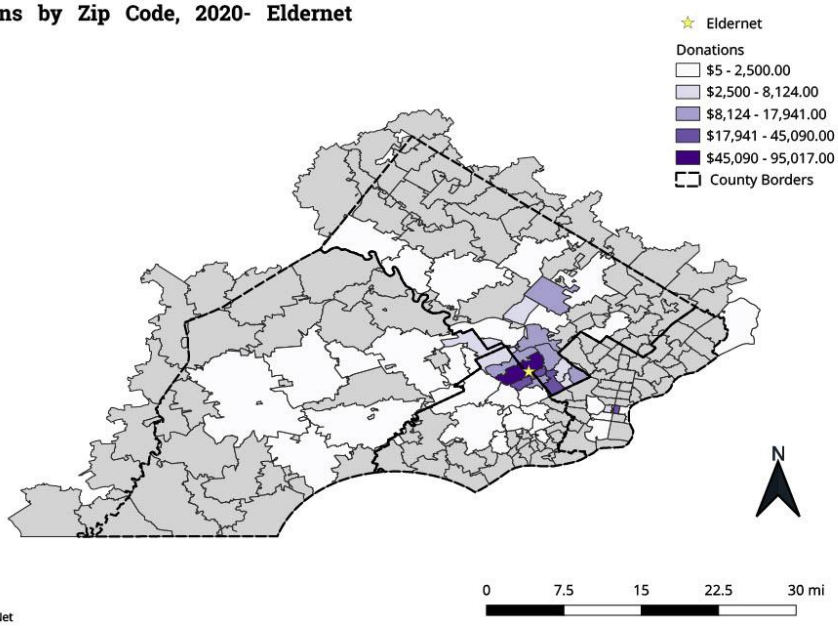
Donations by Zip Code, 2019- Eldernet Region



Source: ElderNet

Appendix 8: Donations 2020 Map

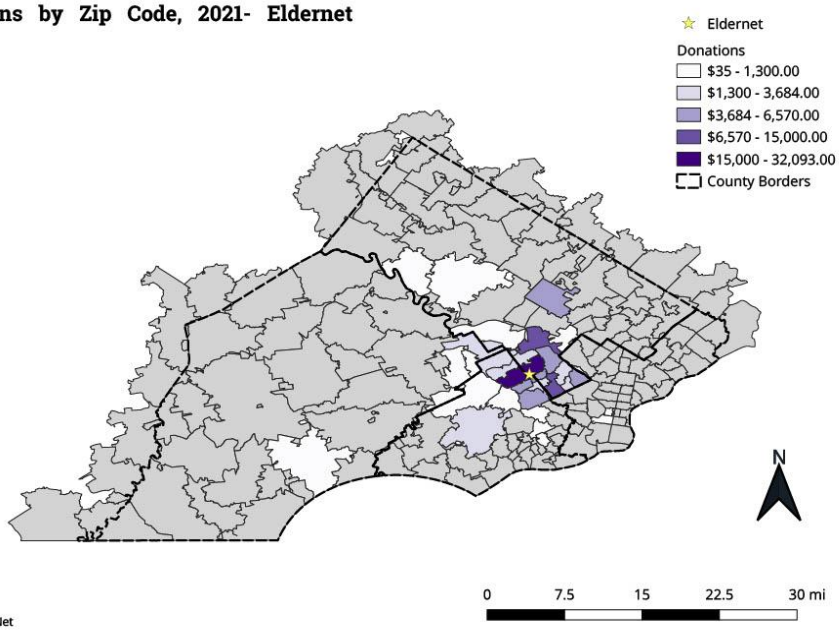
Donations by Zip Code, 2020- Eldernet Region



Source: ElderNet

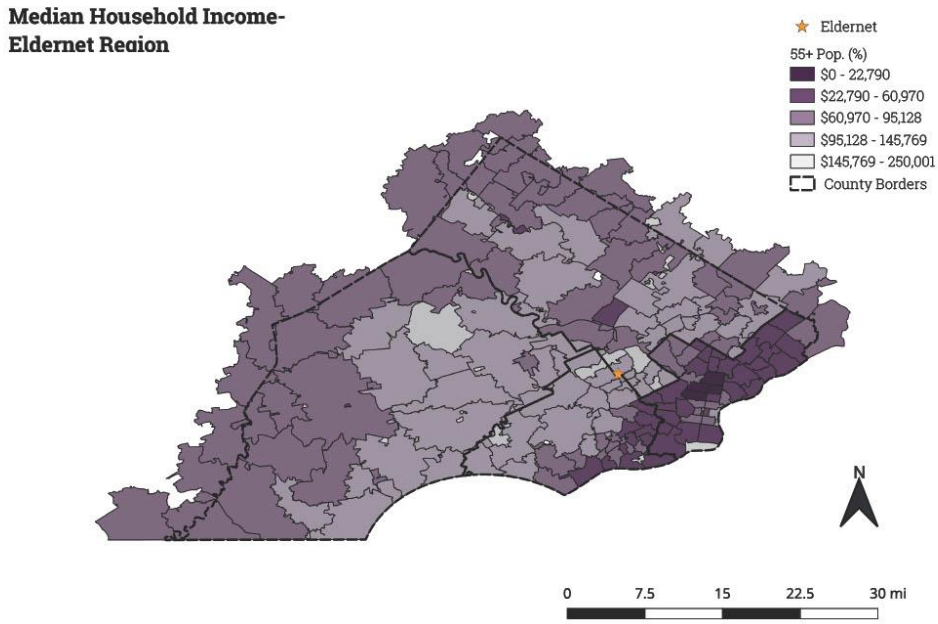
Appendix 9: Donations 2021 Map

Donations by Zip Code, 2021- Eldernet Region



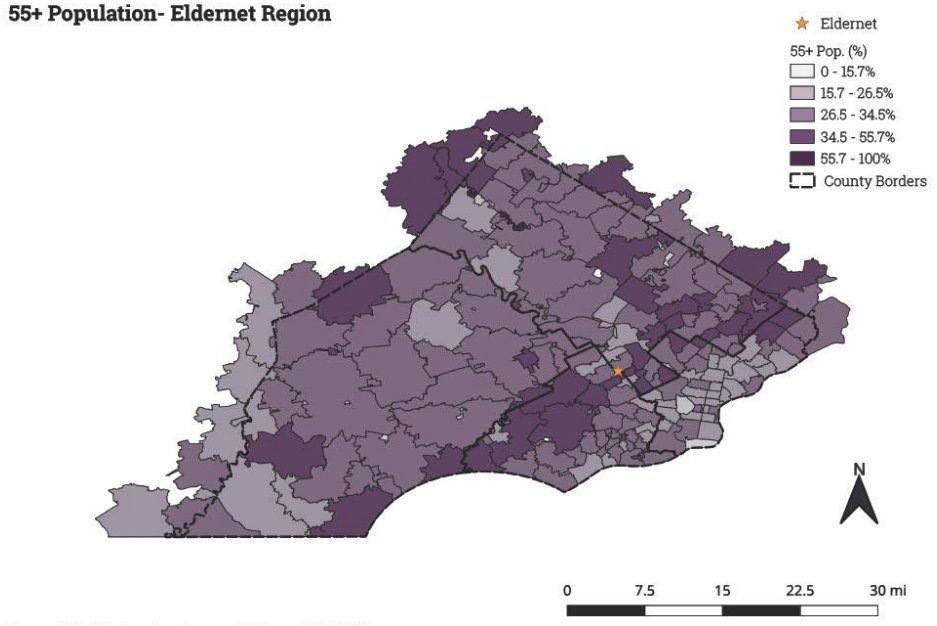
Source: ElderNet

Appendix 10: Median Household Income Map



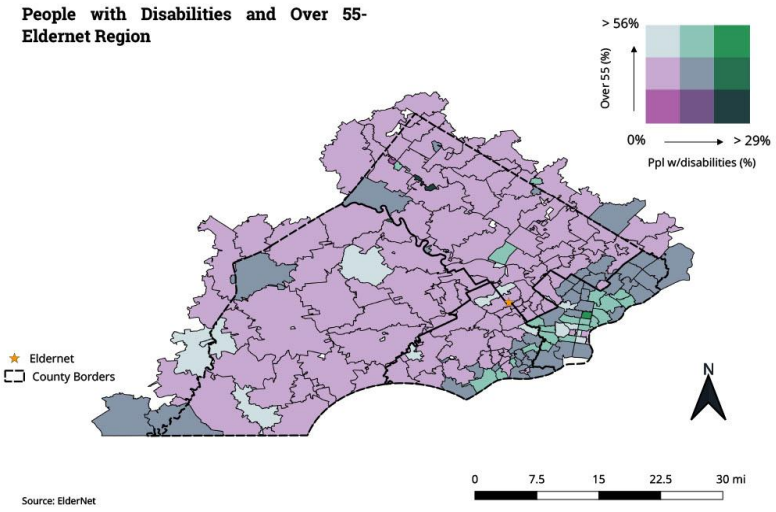
Source: ElderNet, American Community Survey 2015-2019

Appendix 11: Population Over 55 Map

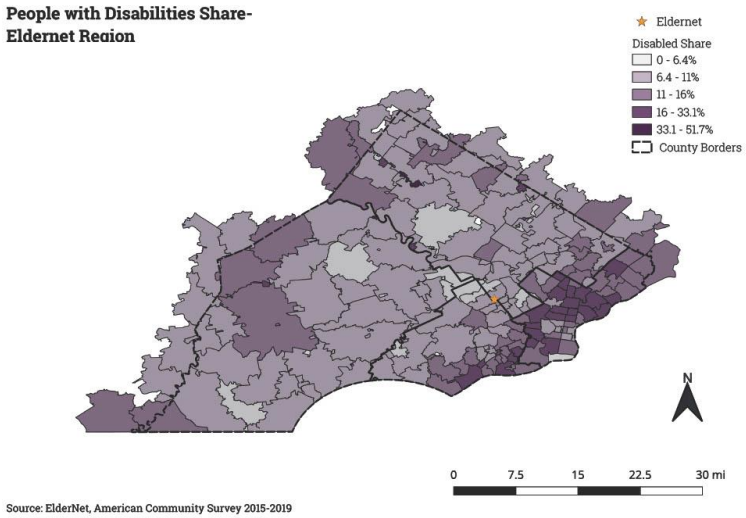


Source: ElderNet, American Community Survey 2015-2019

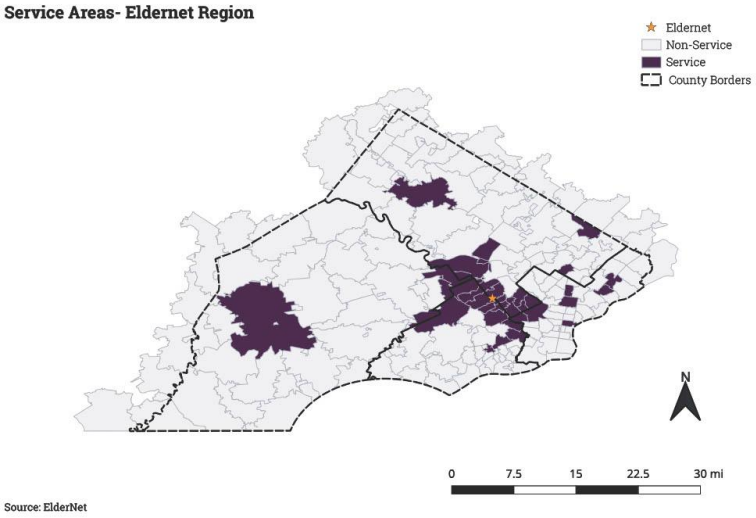
Appendix 12: Population with Disabilities and Over 55 Map



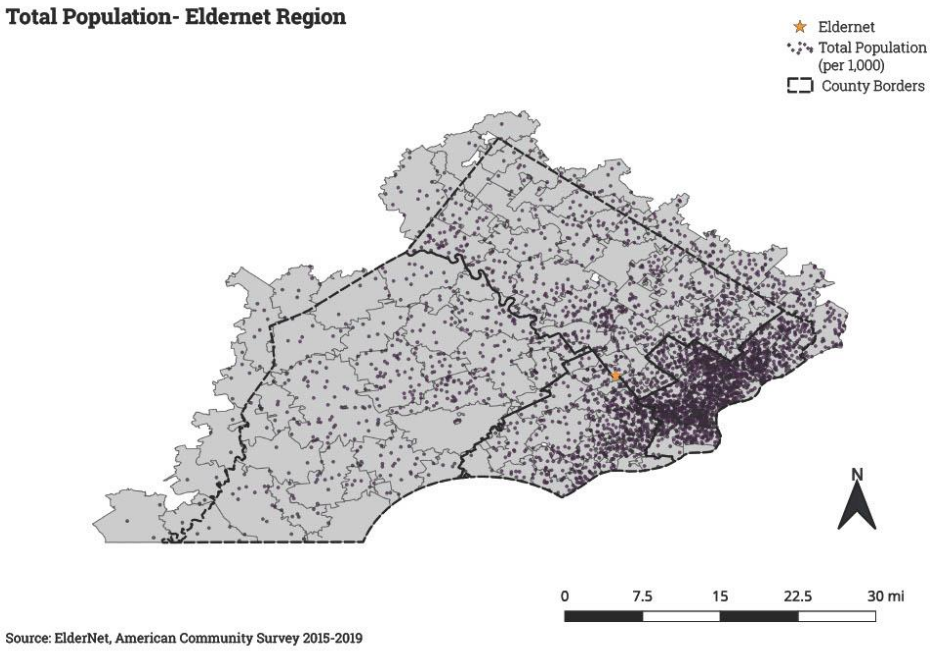
Appendix 13: Population with Disabilities



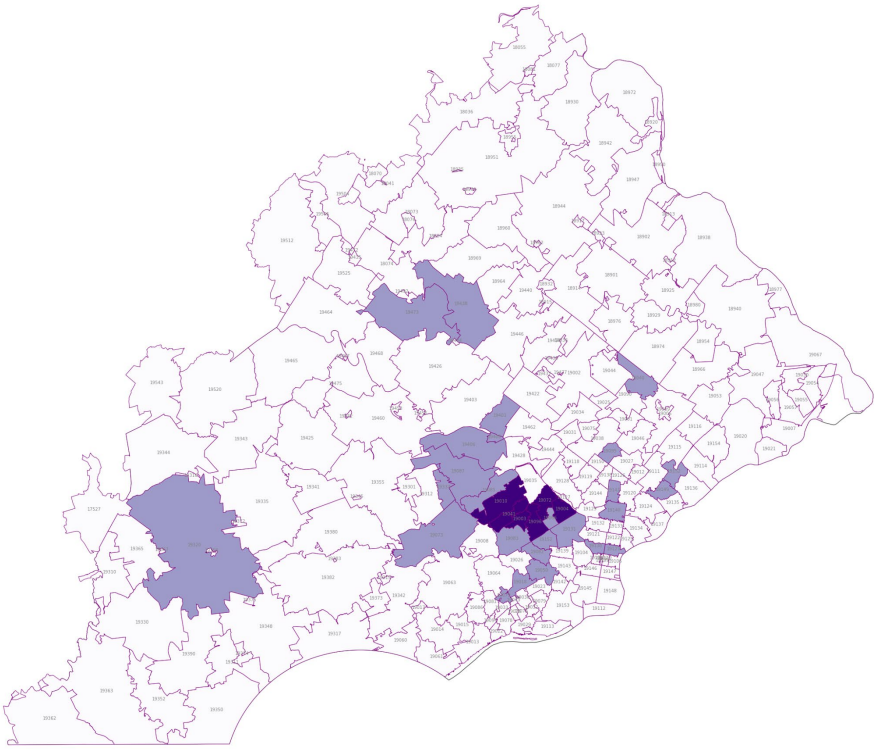
Appendix 14: ElderNet Service Area



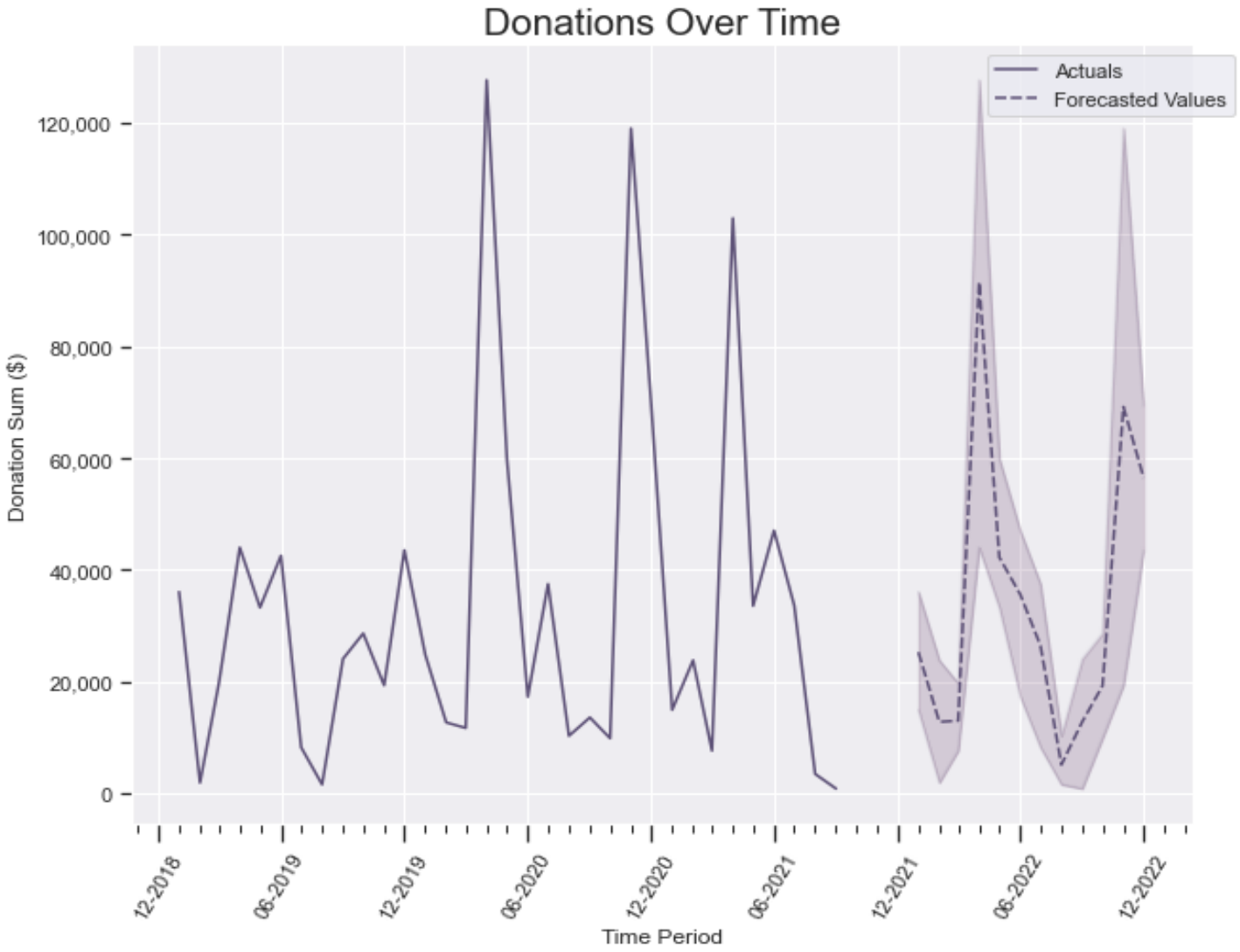
Appendix 15: Total Population Map

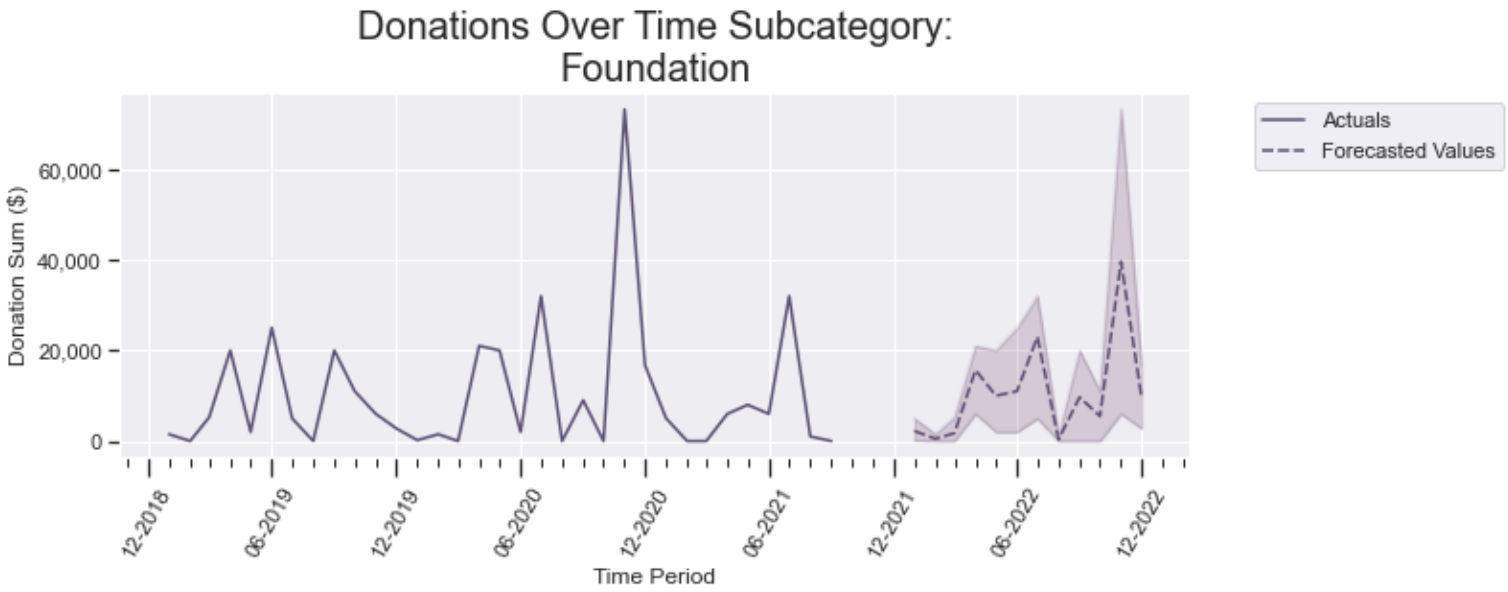


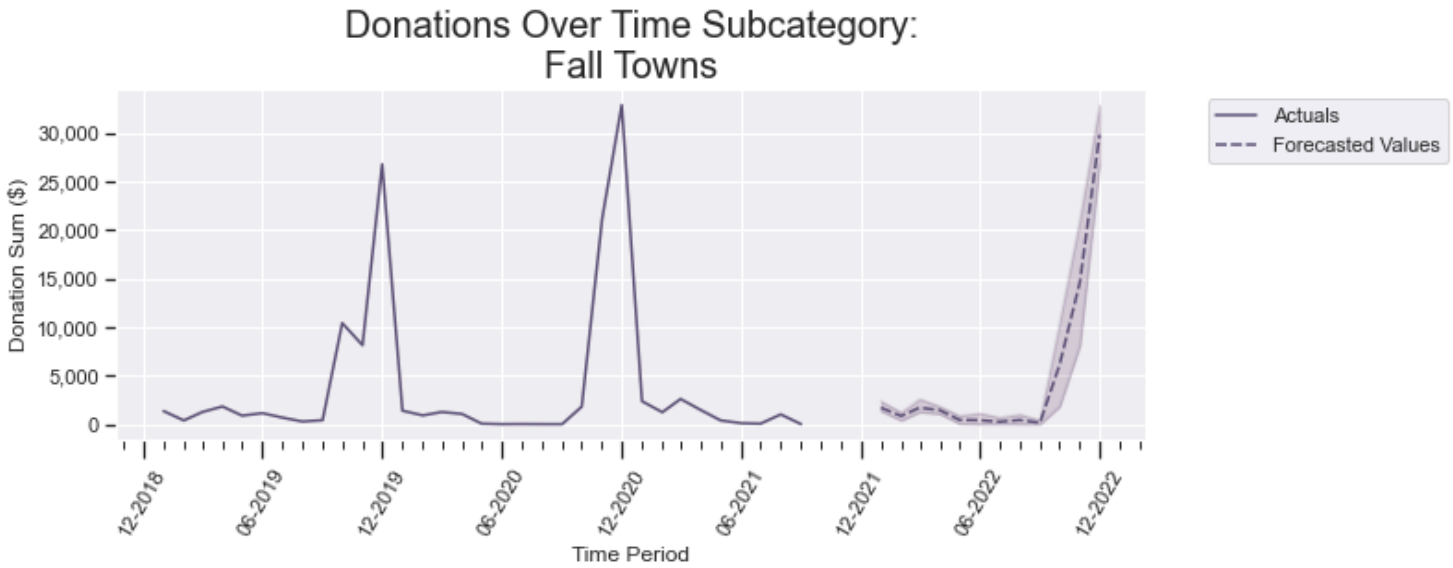
Appendix 16: ZIP Code Reference Map with ElderNet Clients

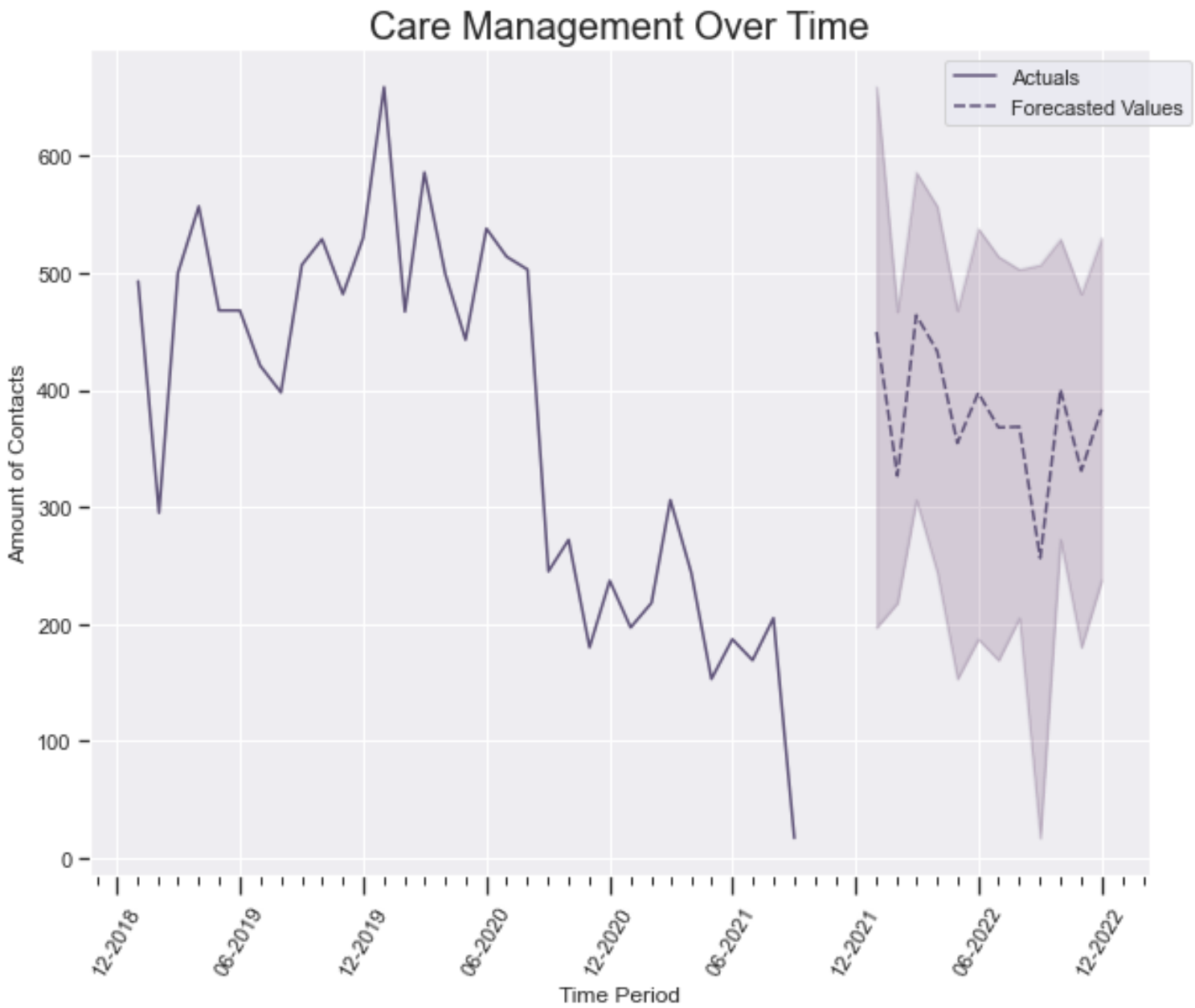


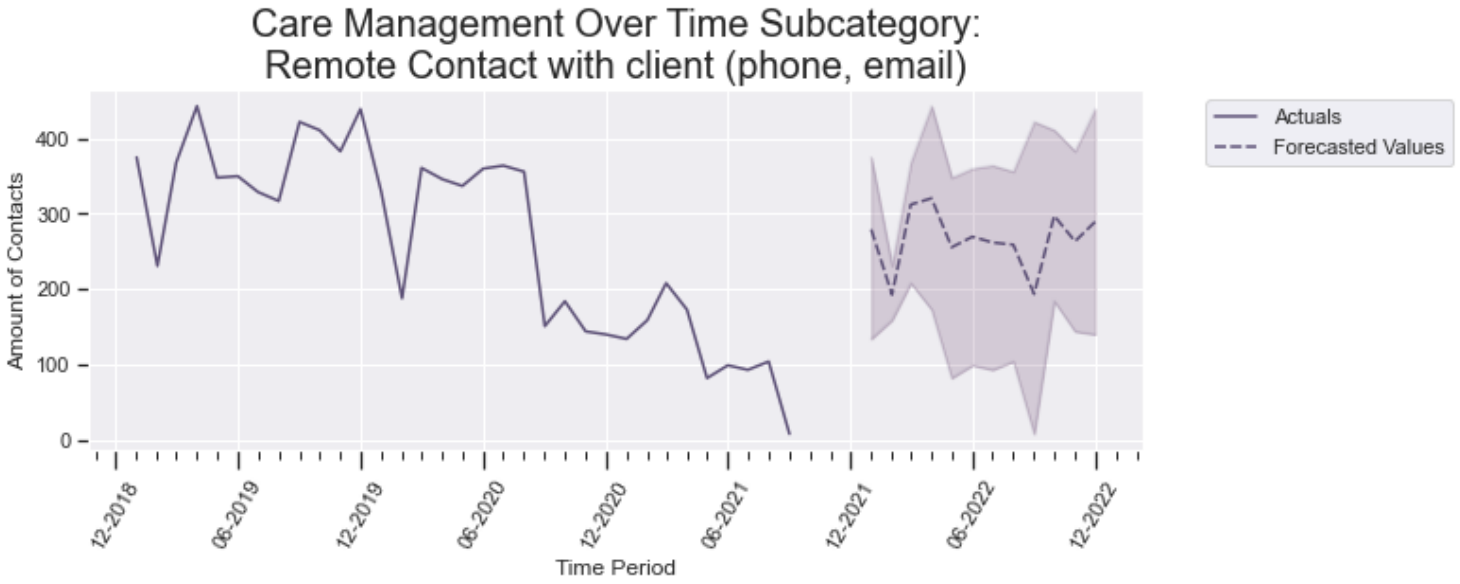
Appendix 17: Data Forecasted with Mean, Range

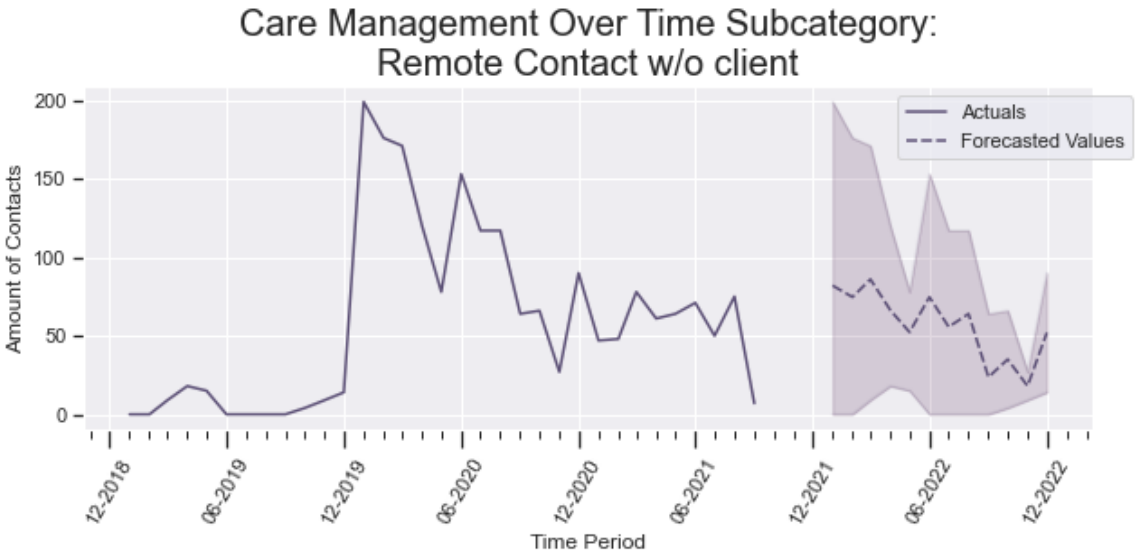


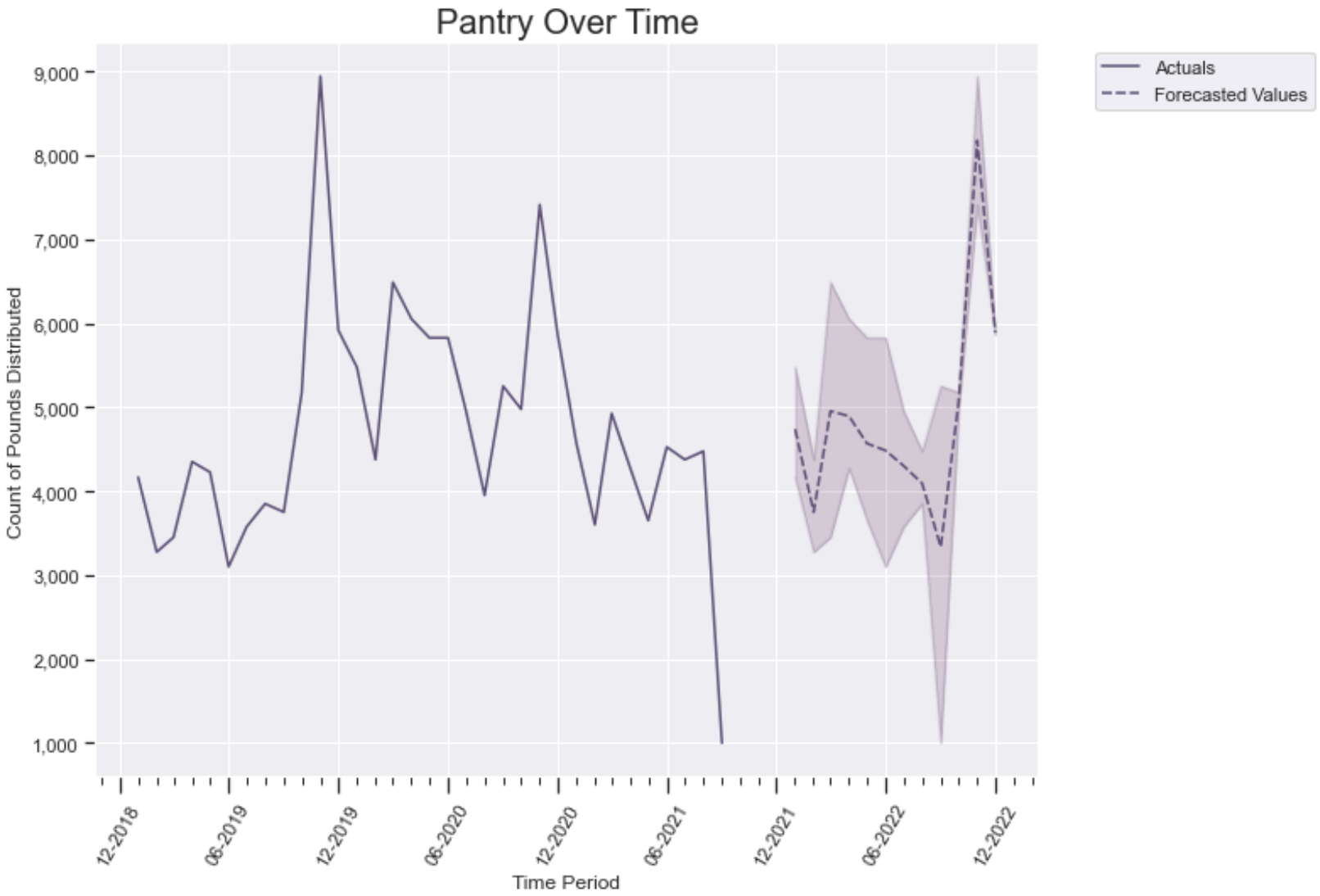

Donations Over Time Subcategory:
Foundation
Donation Sum ($)
60,000
40,000
20,000
0
12-2018
06-2019
12-2019
06-2020
12-2020
06-2021
12-2021
06-2022
12-2022
Time Period
Actuals
Forecasted Values

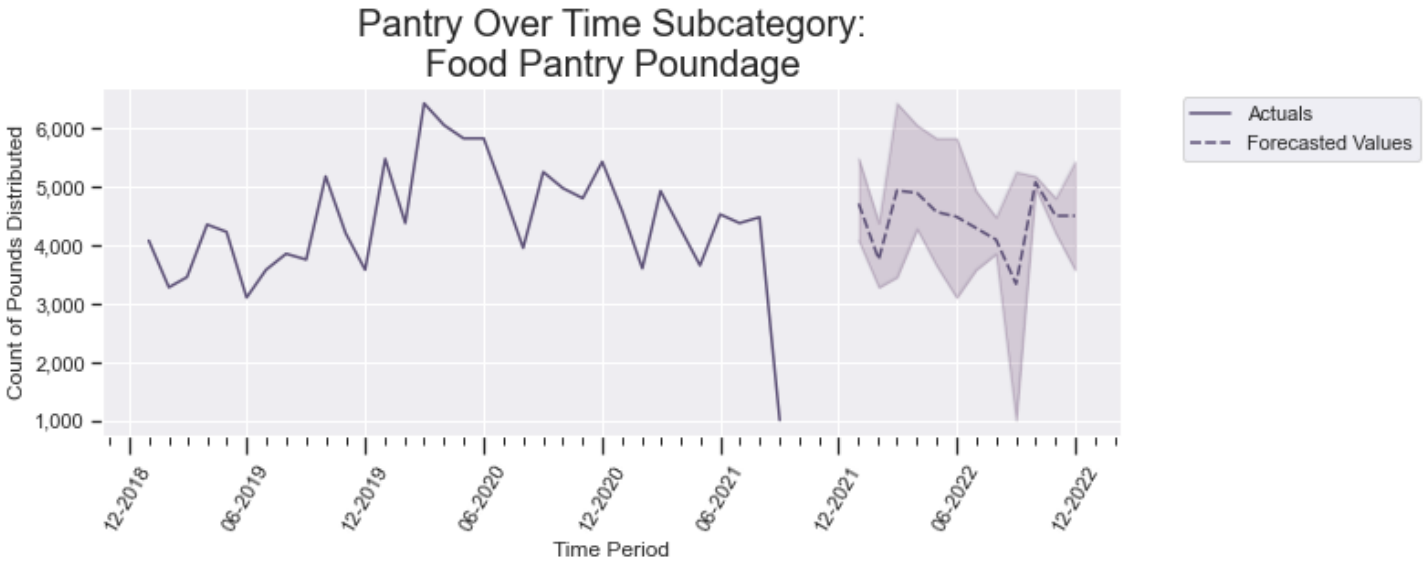

Donations Over Time Subcategory:
Fall Towns
Donation Sum ($)
30,000
25,000
20,000
15,000
10,000
5,000
0
12-2018
06-2019
12-2019
06-2020
12-2020
06-2021
12-2021
06-2022
12-2022
Time Period
Actuals
Forecasted Values

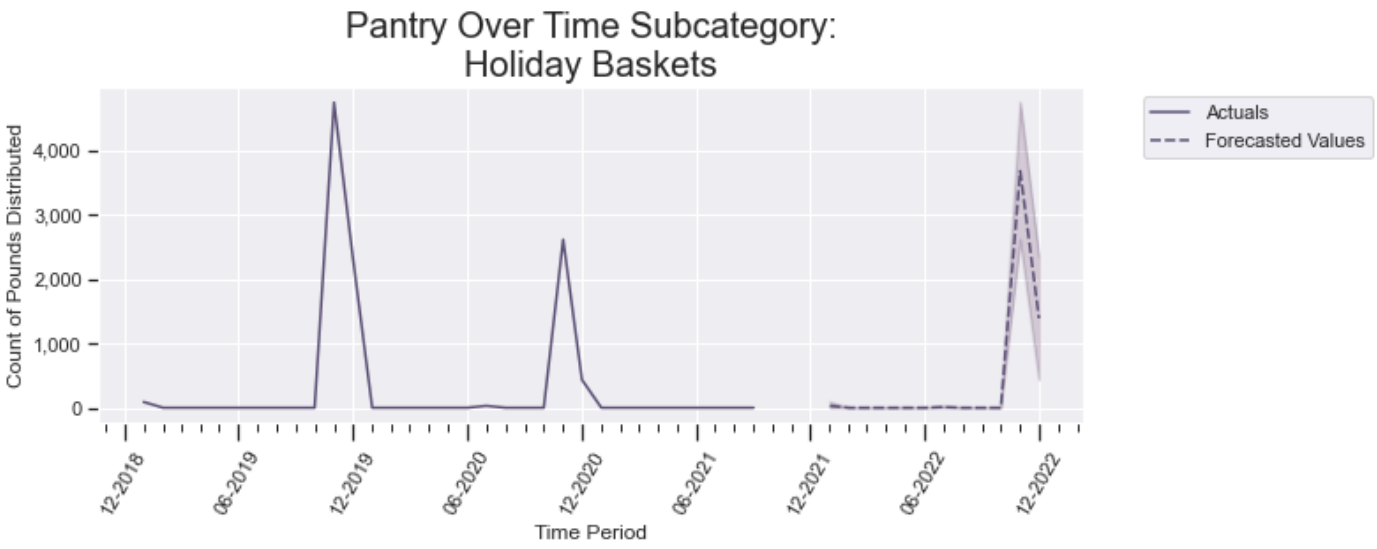

Care Management Over Time
Actuals
Forecasted Values
Amount of Contacts
0
100
200
300
400
500
600
12-2018
06-2019
12-2019
06-2020
12-2020
06-2021
12-2021
06-2022
12-2022
Time Period

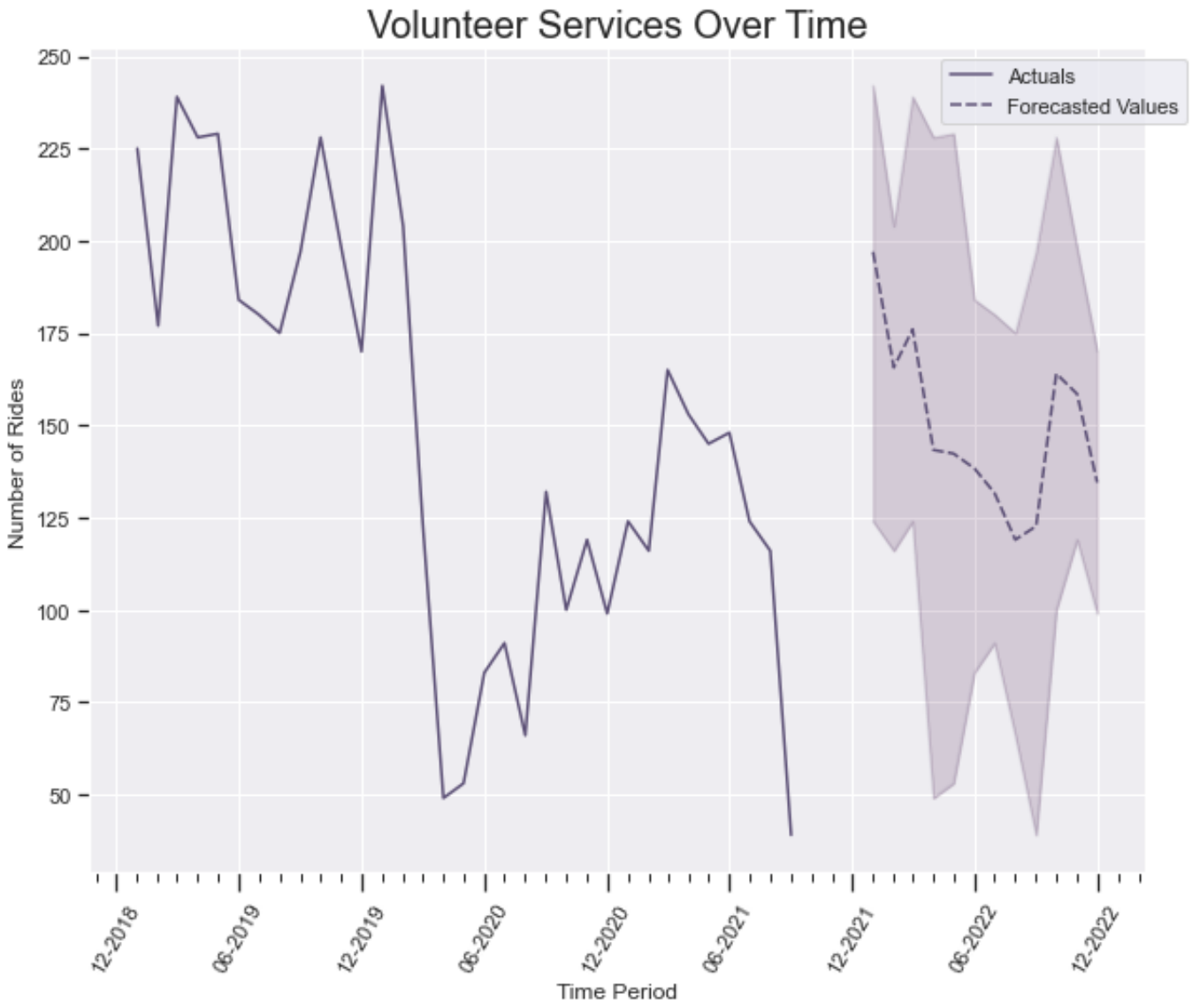

Care Management Over Time Subcategory:
Remote Contact with client (phone, email)
Amount of Contacts
0
100
200
300
400
12-2018
06-2019
12-2019
06-2020
12-2020
06-2021
12-2021
06-2022
12-2022
Time Period
Actuals
Forecasted Values

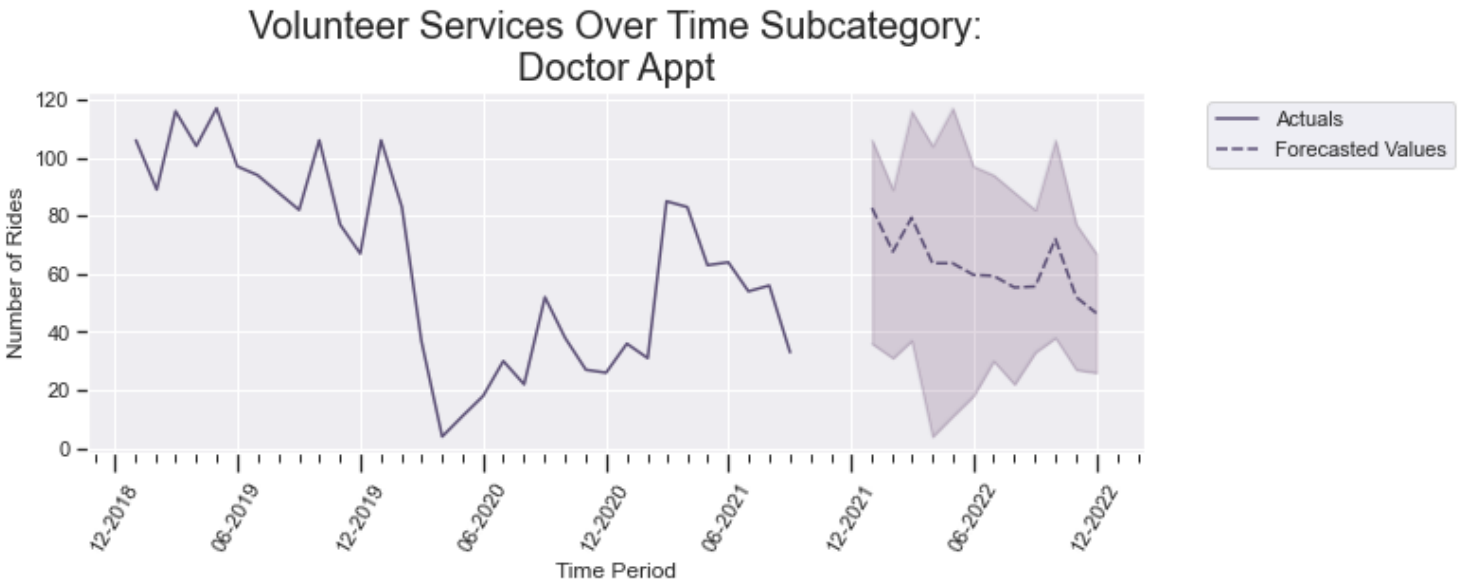

Care Management Over Time Subcategory:
Remote Contact w/o client
Amount of Contacts
0
50
100
150
200
12-2018
06-2019
12-2019
06-2020
12-2020
06-2021
12-2021
06-2022
12-2022
Time Period
Actuals
Forecasted Values

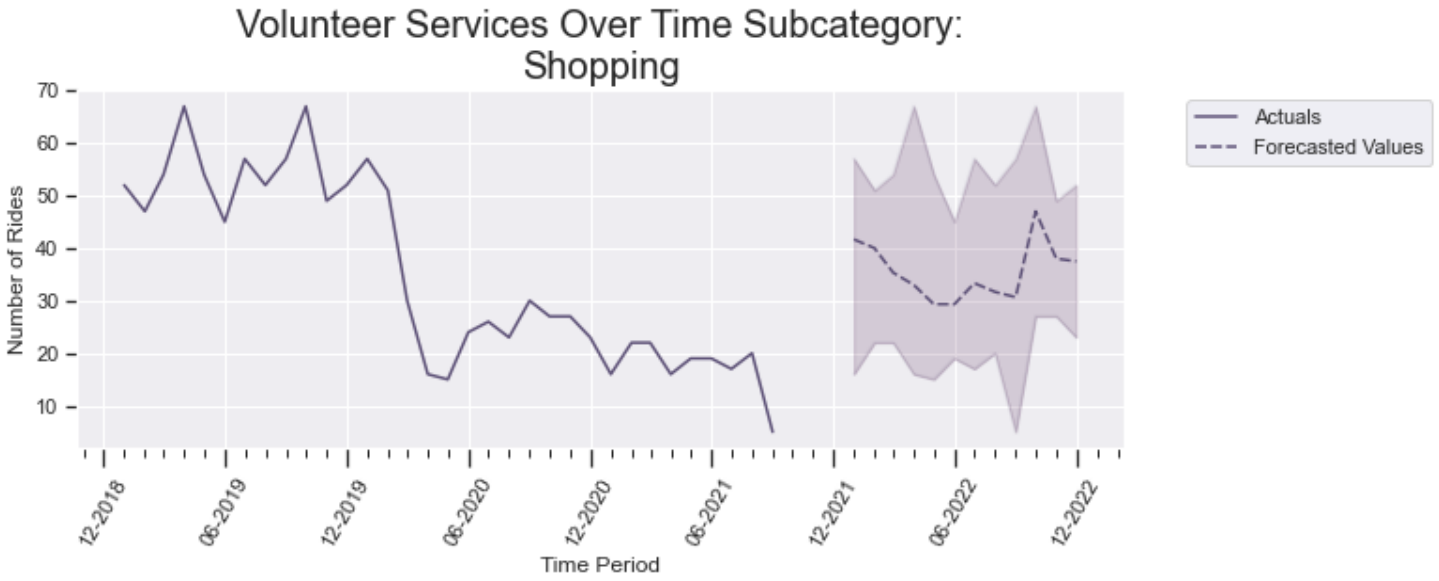

Pantry Over Time
Actuals
Forecasted Values
Count of Pounds Distributed
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
12-2018
06-2019
12-2019
06-2020
12-2020
06-2021
12-2021
06-2022
12-2022
Time Period


Pantry Over Time Subcategory:
Food Pantry Poundage
Count of Pounds Distributed
6,000
5,000
4,000
3,000
2,000
1,000
12-2018
06-2019
12-2019
06-2020
12-2020
06-2021
12-2021
06-2022
12-2022
Time Period
Actuals
Forecasted Values

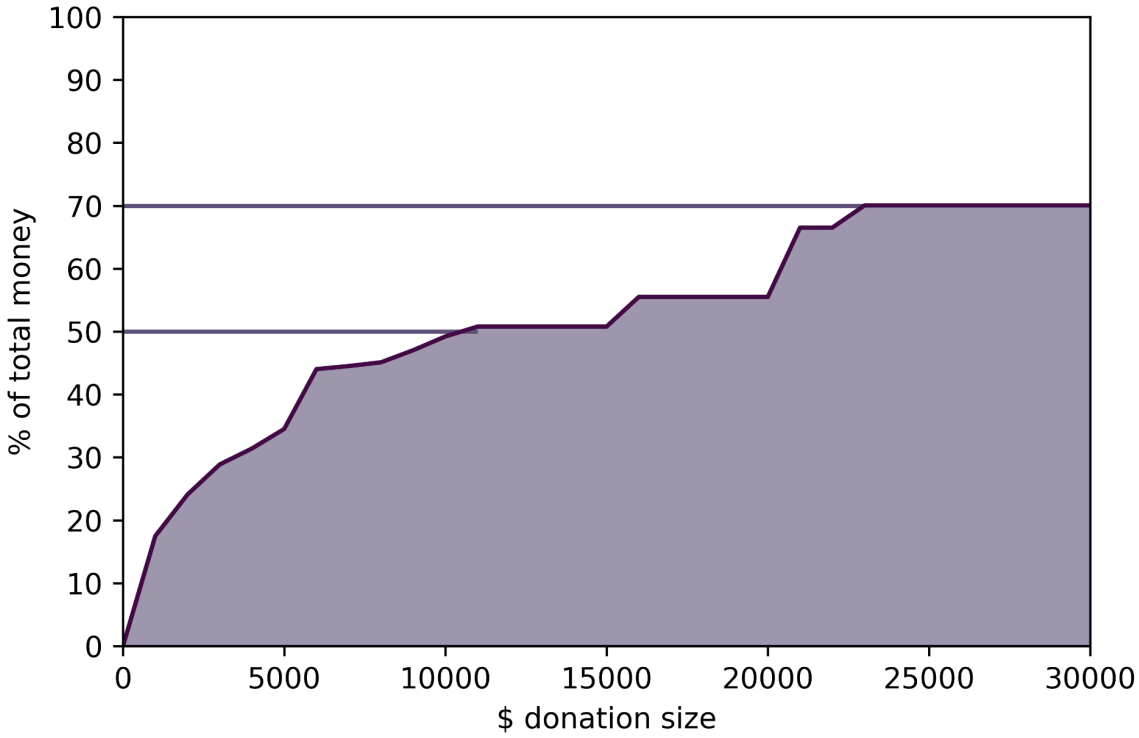

Pantry Over Time Subcategory:
Holiday Baskets
Count of Pounds Distributed
4,000
3,000
2,000
1,000
0
12-2018
06-2019
12-2019
06-2020
12-2020
06-2021
12-2021
06-2022
12-2022
Time Period
Actuals
Forecasted Values

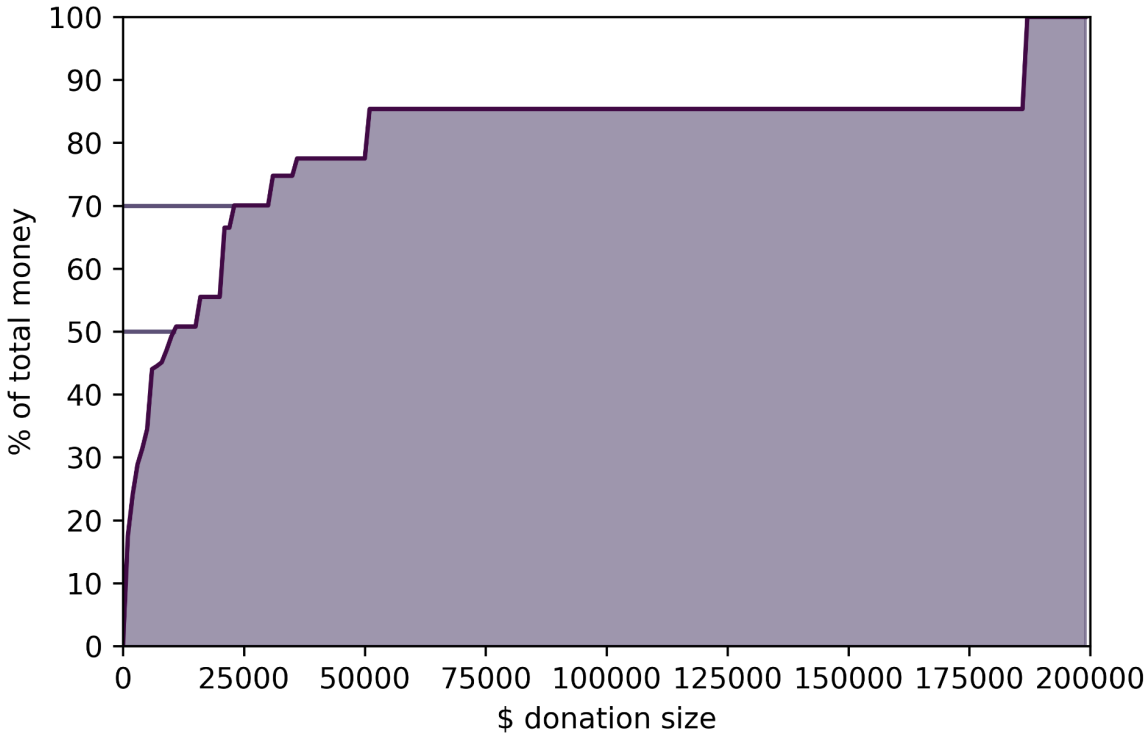

Volunteer Services Over Time
Actuals
Forecasted Values
Number of Rides
250
225
200
175
150
125
100
75
50
12-2018
06-2019
12-2019
06-2020
12-2020
06-2021
12-2021
06-2022
12-2022
Time Period


Volunteer Services Over Time Subcategory:
Doctor Appt
Number of Rides
120
100
80
60
40
20
0
12-2018
06-2019
12-2019
06-2020
12-2020
06-2021
12-2021
06-2022
12-2022
Time Period
Actuals
Forecasted Values

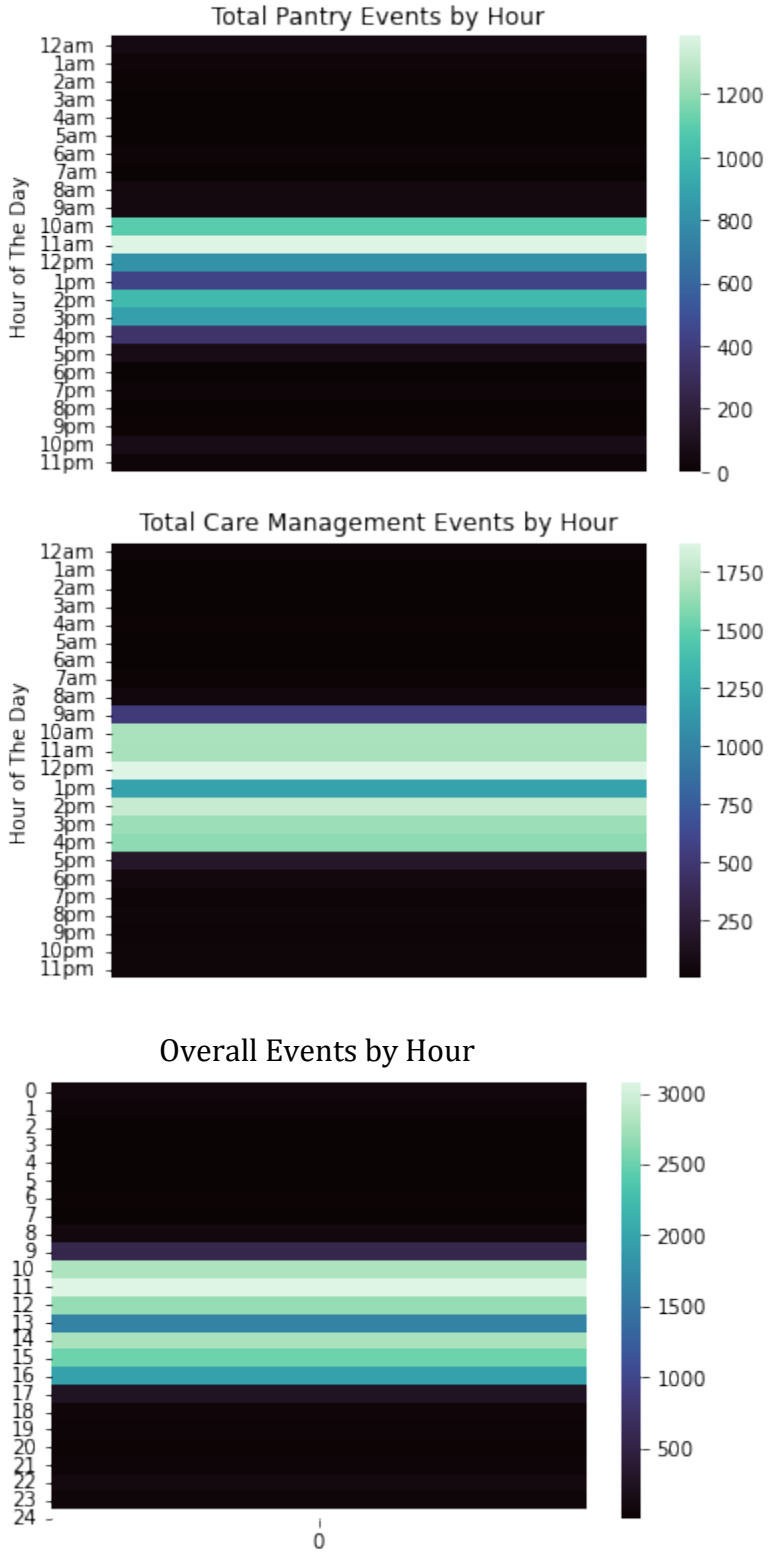

Volunteer Services Over Time Subcategory:
Shopping
Number of Rides
70
60
50
40
30
20
10
12-2018
06-2019
12-2019
06-2020
12-2020
06-2021
12-2021
06-2022
12-2022
Time Period
Actuals
Forecasted Values

Appendix 18: Cumulative Sum of Donations in Ascending Order

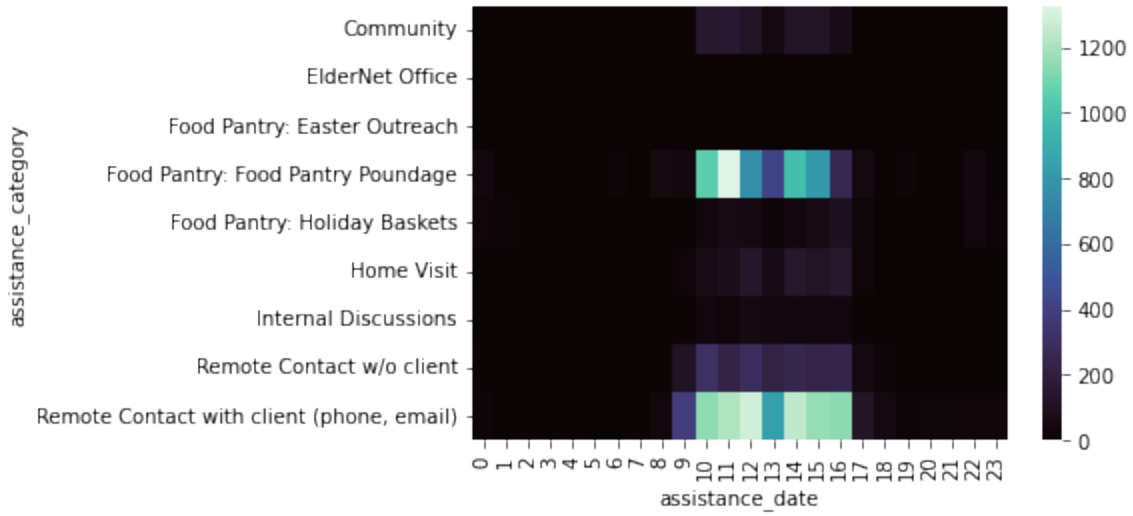




Appendix 19: Heatmap of Events by Hour (pantry and community)



Event Counts by Type And Hour of Day


Community
ElderNet Office
Food Pantry: Easter Outreach
Food Pantry: Food Pantry Poundage
Food Pantry: Holiday Baskets
Home Visit
Internal Discussions
Remote Contact w/o client
Remote Contact with client (phone, email)
assistance_category
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
assistance_date
1200
1000
800
600
400
200
0