

# SDOH Matching System

Matthew Walker

# Background Information

Social Determinants of  
Health

Assistance Programs  
and Organization



Social Care Coordinators

# Data I was Given

## Responses

800,000 row excel file  
Each row represents one question

ID	Employment
Time Passed	Education
Gender	Tobacco Usage
Age	CAD
Race	CHF
Ethnicity	COPD
Encounter Type	Diabetes
Department ID	Hypertension

Demographic Information

Question ID
Question Name
Results

Question-Response

[SDOH Data Excel Sheet](#)

# Data I was Given

## Questionnaire

## Referrals

### 1. Food

In the last 12 months:

- Have you worried your food would run out before you had money to buy more?  
☐ Never   ☐ Sometimes   ☐ Often
- Did the food you bought just not last and you didn't have money to buy more?  
☐ Never   ☐ Sometimes   ☐ Often

### 2. Transportation

In the last 12 months, has the lack of transportation:

- Kept you from medical appointments or from getting medications?   ☐ Yes   ☐ No
- Kept you from meetings, work, or getting things needed for daily living?   ☐ Yes   ☐ No

### 3. Internet Access

Do you currently have internet access at home?   ☐ Yes   ☐ No

Do you have internet access on a device or in another location?   ☐ Yes   ☐ No

If Yes, where?   ☐ On a cell phone   ☐ At work   ☐ Other (such as Library)   ☐ Multiple access options

### 4. Housing Stability

In the last 12 months, were you ever **unable** to pay the rent or mortgage on time?   ☐ Yes   ☐ No

In the last 12 months, how many places have you lived?  

In the last 12 months, did you ever sleep in a shelter or **not** have a steady place to sleep?   ☐ Yes   ☐ No

### 14. Request for Assistance:

We may be able to connect you with resources and agencies that can help you by making a referral on your behalf. Would you like help with any of following?

Please check all that apply:

- ☐ Food  
☐ Transportation  
☐ Internet Access  
☐ Housing stability  
☐ Housing problems (mold, pests, leaks, lead, smoke detectors)

☐ Finances  
☐ Employment  
☐ Education  
☐ Stress  
☐ Social Connections  
☐ Physical Activity

ID	Referral.ID	Original.Date.Created	Referred.To.Group.Name	Service.Type
148956	810075	2/3/2021 13:55	Achievement Centers for Children - Highland Hills	Individual & Family Support
189703	533009	1/21/2021 19:25	Benjamin Rose Institute on Aging - Ernst J Bohn Rose Center (Deactivated)	Food Assistance
93880	859428	1/21/2021 19:25	Benjamin Rose Institute on Aging - East Cleveland Rose Center at Salvation Army	Food Assistance
26910	222319	12/22/2020 20:00	Benjamin Rose Institute on Aging - Ernst J Bohn Rose Center (Deactivated)	Food Assistance
61860	765572	2/22/2021 19:16	Benjamin Rose Institute on Aging - East Cleveland Rose Center at Salvation Army	Food Assistance
39161	496976	2/24/2021 19:58	Greater Cleveland Food Bank	Food Assistance
128818	370089	12/29/2020 21:27	Benjamin Rose Institute on Aging - Rose Centers Home Delivered Meals	Food Assistance
166902	511671	12/28/2020 17:37	Benjamin Rose Institute on Aging - Main	Food Assistance
49314	931086	12/22/2020 19:13	Benjamin Rose Institute on Aging - Main	Individual & Family Support
123739	569376	12/28/2020 17:37	Benjamin Rose Institute on Aging - Main	Housing & Shelter
168978	499029	1/14/2021 14:35	Benjamin Rose Institute on Aging - Main	Benefits Navigation
39255	859584	1/14/2021 15:13	Benjamin Rose Institute on Aging - Main	Utilities
192792	352236	1/21/2021 19:28	Benjamin Rose Institute on Aging - Main	Housing & Shelter
74562	704412	1/28/2021 16:59	Benjamin Rose Institute on Aging - Main	Utilities
22444	642327	1/28/2021 16:56	Benjamin Rose Institute on Aging - Main	Housing & Shelter
77662	943882	2/3/2021 17:36	Benjamin Rose Institute on Aging - Main	Mental/Behavioral Health
194759	262450	2/9/2021 16:25	Benjamin Rose Institute on Aging - Main	Housing & Shelter
108491	420791	12/2/2020 18:51	Benjamin Rose Institute on Aging - Main	Housing & Shelter
134486	538816	12/10/2020 16:31	Benjamin Rose Institute on Aging - Main	Food Assistance
41083	234553	12/14/2020 17:30	Benjamin Rose Institute on Aging - Main	Housing & Shelter
162759	862082	1/21/2021 19:25	Benjamin Rose Institute on Aging - James Woods Rose Center	Food Assistance
97932	618766	2/17/2021 17:23	Benjamin Rose Institute on Aging - James Woods Rose Center	Food Assistance
4705	852675	2/17/2021 17:23	Benjamin Rose Institute on Aging - James Woods Rose Center	Food Assistance
117900	978055	12/14/2020 21:04	Benjamin Rose Institute on Aging - James Woods Rose Center	Food Assistance
172751	717468	12/29/2020 21:27	Benjamin Rose Institute on Aging - Gunning Park Rose Center	Food Assistance
84120	879496	12/30/2020 20:03	Benjamin Rose Institute on Aging - Gunning Park Rose Center	Food Assistance
166866	714766	1/21/2021 19:25	Benjamin Rose Institute on Aging - Gunning Park Rose Center	Food Assistance
20367	734630	12/11/2020 17:07	Benjamin Rose Institute on Aging - Gunning Park Rose Center	Food Assistance
133393	331634	12/3/2020 16:23	Audrey's Outreach	Clothing & Household Goods

# Goal of Project

- Create matching system between clients and resources
- Match results of questionnaire to organizations/programs
- Replicate work of social care coordinators
- “Automated social care coordinator”

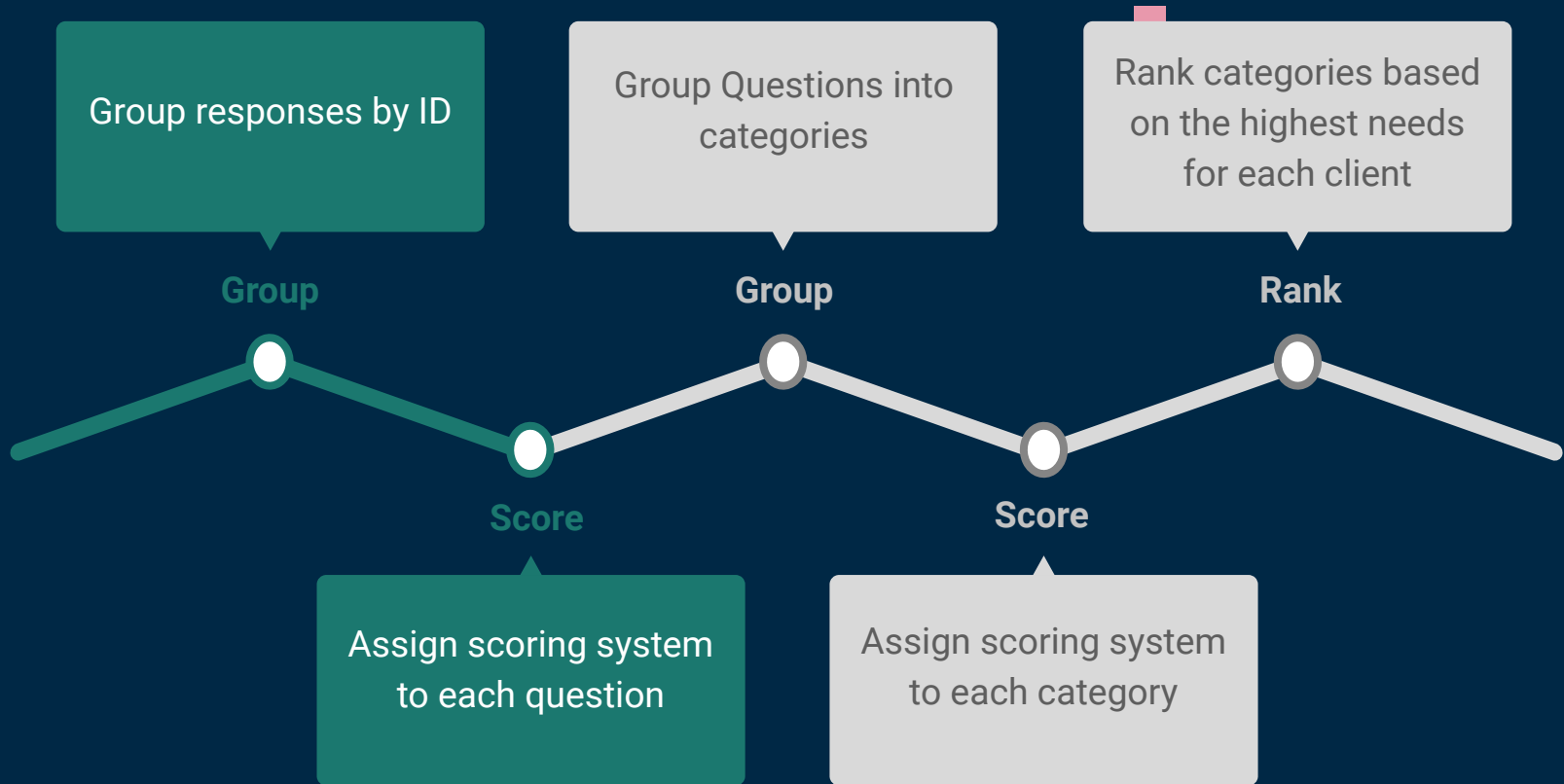
Disclaimer: Additional factors go into the matching process beyond the answers to the questionnaire, so this tool could only be used as an aid to social care coordinators

# Original Idea - Failed

Demographic Info + Question/Response = Referral

- Build predictive model
- Would replicate decisions of professionals
  - No self-input in decisions
- Could not achieve this with dataset
  - Random sample

# New Idea - Scoring System



# Scoring System Breakdown

\*Matching System created based only on answers to questions

Does not require “correct”  
data for creation, just  
complete data



Highest need  
determines matching  
process

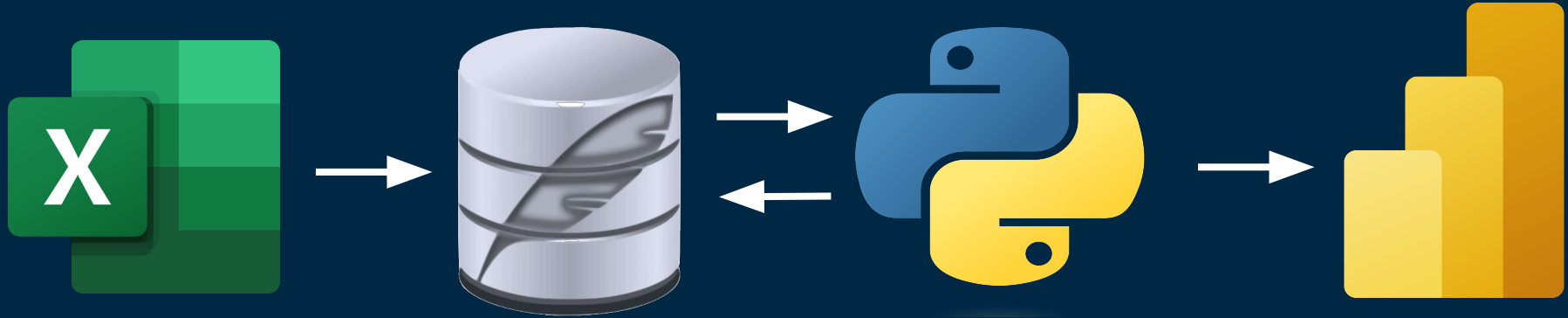
Filtered dataset to  
responses > 25  
517 results



Downside = based on my  
own non-professional input



# Data Science Tools

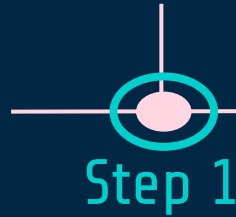


# Step-by-Step Walkthrough

1. Pre-Processing Data
2. Group Questions into Categories
3. Scaling Data
4. Ranking Categories
5. Matching System Simulation
6. PowerBI Dashboard

# Pre-Processing

Map coded responses to  
real responses



```
(1572879810, '1'): 'Very hard',  
(1572879810, '2'): 'Hard',  
(1572879810, '3'): 'Somewhat hard',  
(1572879810, '4'): 'Not very hard',  
(1572879810, '5'): 'Not hard at all',  
  
(1572879823, '1'): 'Not at all',  
(1572879823, '2'): 'Only a little',  
(1572879823, '3'): 'To some extent',  
(1572879823, '4'): 'Rather much',  
(1572879823, '5'): 'Very Much',
```

Map real responses to new  
ordinal codes and one-hot  
encoding



```
(1572879810, 'Very hard'): 5,  
(1572879810, 'Hard'): 4,  
(1572879810, 'Somewhat hard'): 3,  
(1572879810, 'Not very hard'): 2,  
(1572879810, 'Not hard at all'): 1,  
  
(1572879823, 'Not at all'): 1,  
(1572879823, 'Only a little'): 2,  
(1572879823, 'To some extent'): 3,  
(1572879823, 'Rather much'): 4,  
(1572879823, 'Very Much'): 5,
```

Pivot data so each row = full  
questionnaire for single ID



FinalAnswers  
and  
FinalAttributes  
tables in SQLite

# Group Questions into Categories

## 12 Categories:

Food

Transportation

Internet Access

Housing Stability

Housing Problems

Personal Safety

Financial Stability

\*Employment

\*Education

Stress

Social Connections

Physical Activity

Goal: mathematically integrate question scores into categories

## 2 Questions:

- How to combine values on to same scale?
- Value of each question?

# Group Questions into Categories

Used my un-professional input to  
decide question values

## 12. Social Connections

How often do you get together with friends or relatives?

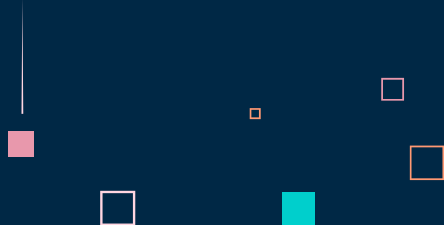
☐ Never    ☐ Once a week    ☐ Twice a week    ☐ Three times a week    ☐ More than 3 x week

Scale: 0-3

Do you belong to any clubs or organizations (such as church groups, unions, fraternal, athletic, or school)?

☐ Yes    ☐ No

Scale: 0-0.5



- Combine questions onto same scale
- Range of scales for each category not important at this point

```
max_values = {  
    'Food' : 4,  
    'Transportation' : 2,  
    'InternetAccess' : 2,  
    'HousingStability' : 13.5,  
    'HousingProblems' : 11,  
    'PersonalSafety' : 4,  
    'FinancialStability' : 4,  
    'Stress' : 4,  
    'SocialConnections' : 7,  
    'PhysicalActivity' : 6  
}
```

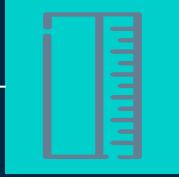
# Scoring System Table

- Rows = ID
- Columns = SDOH category
- Values = scores

RawScoresQuestionsOnly table in SQLite



# Scaling Process



01

## Convert to 0-100 Scale

- Divide by category max score (0-1 scale)
- Multiply by 100



02

## Multiply by Importance Level

- Range from 1-3
- Some categories prioritized over others
- Unprofessional input



03

## Request for Assistance Boost

- Add 100 if assistance requested
- Balances client's desires with model's logic

# Scaling Process - Example

ID	Food	Transportation	SocialConnections
94131	2	1	3.5

01

Food: 50

$(2 / 4) * 100$

Transportation: 50

$(1 / 2) * 100$

Social: 50

$(3.5 / 7) * 100$

02

Food: 150

$50 * 3$

Transportation: 100

$50 * 2$

Social: 100

$50 * 2$

03

Food: 250

$150 + 100$

Transportation: 200

$100 + 100$

Social: 100

$100 + 0$

ID	Food	Transportation	SocialConnections
94131	250	200	100

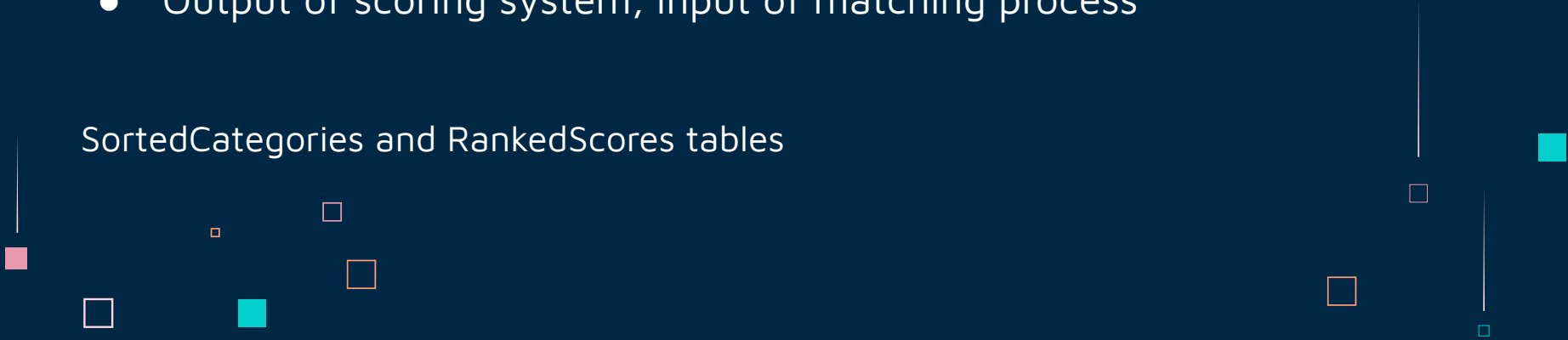


# Ranking Categories

List of categories is generated from model for each client

- Based on scoring system
- Excludes scores of 0
- Output of scoring system, input of matching process

SortedCategories and RankedScores tables



# Resource Domain Table

	Category	Resource
1	Food	Greater Cleveland Food Bank
2	Transportation	United Way-Lyft Partnership Program
3	InternetAccess	EmpowerCLE+
4	HousingStability	CHN Housing Partners
5	HousingProblems	Home Repair Resource Center
6	PersonalSafety	Haven House Family Shelter
7	FinancialStability	United Way
8	Employment	Towards Employment
9	Education	College Now Greater Cleveland
10	Stress	University Hospitals - SMART Program
11	SocialConnections	Behavioral Health Services of Greater Cleveland
12	PhysicalActivity	YMCA of Greater Cleveland
13	Food	Hunger Network of Greater Cleveland
14	Transportation	Provide a Ride
15	InternetAccess	Connecting to Possibility (AT&T-Metrohealth Partnership)
16	HousingStability	The City Mission
17	HousingProblems	Step Forward Energy Assistance Programs
18	PersonalSafety	Journey Center for Safety & Healing
19	FinancialStability	Benjamin Rose Institute on Aging - Financial Wellness
20	Employment	Recovery Resources - Employment Assistance Program
21	Education	Cleveland Foundation - Say Yes Cleveland Program

- Used by social care coordinator
- Find best resource for highest area of need based on model

# Matching System Simulation

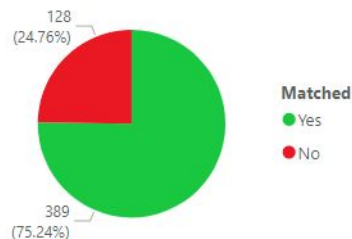
- 75% random sample from 517 IDs
- Randomly assigned resource based on first ranked category
- Marked random date from Jan 1 - Dec 5, 2023
- MatchingSystem table continually updated with new matches



# PowerBI Dashboard

## SDOH Matching System Dashboard

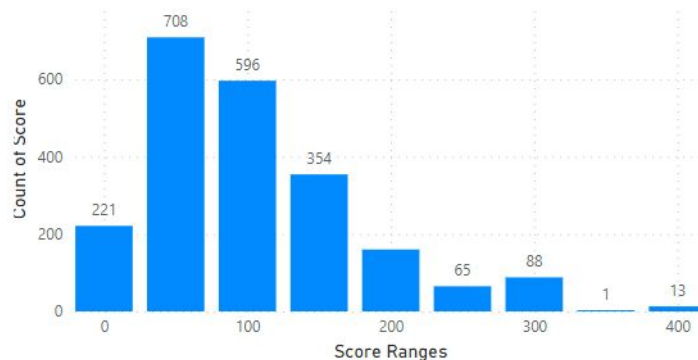
Matching Breakdown



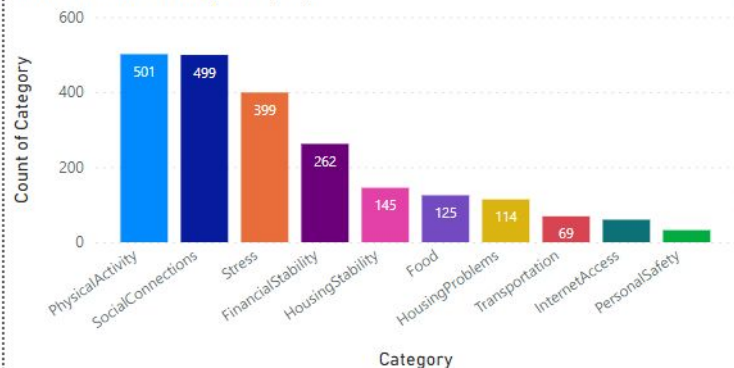
Assistance Requests

Category	TotalRequests
Stress	59.00
PhysicalActivity	51.00
Food	39.00
FinancialStability	33.00
HousingProblems	32.00
Transportation	30.00
HousingStability	27.00
SocialConnections	20.00
Employment	18.00
InternetAccess	18.00
Education	9.00
PersonalSafety	0.00

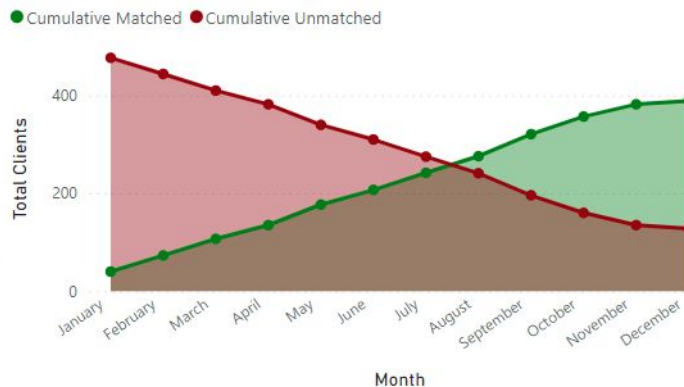
Scoring Distribution



Scores Above Zero by Category



Cumulative Matches Over Time



Category

All

Rank

All

Matched

All

Education

All

Employment

All

Month

☐ January

☐ February

☐ March

☐ April

☐ May

☐ June

☐ July

☐ August

☐ September

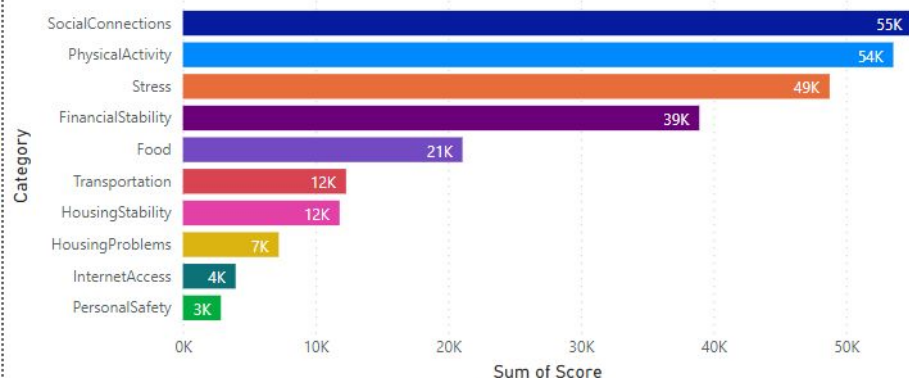
☐ October

☐ November

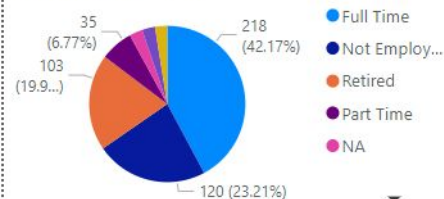
☐ December

# PowerBI Dashboard

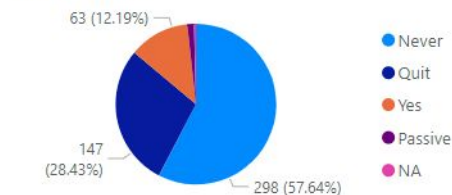
## Score Breakdown



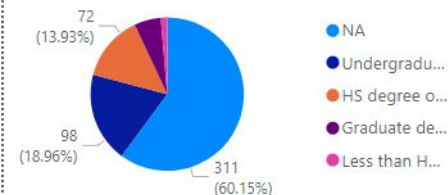
## Employment Status



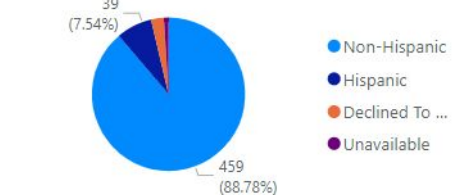
## Tobacco Usage



## Education



## Ethnicity



## Matching System

ID	Resource	Date	ID
104390	Affordable Connectivity Program	7/1/2023	<input type="checkbox"/> 100439
10470	Behavioral Health Services of Greater Cleveland	2/19/2023	<input type="checkbox"/> 100468
109250	Behavioral Health Services of Greater Cleveland	5/8/2023	<input type="checkbox"/> 100581
113325	Behavioral Health Services of Greater Cleveland	4/13/2023	<input type="checkbox"/> 100765
117285	Behavioral Health Services of Greater Cleveland	2/6/2023	<input type="checkbox"/> 101013
1274	Behavioral Health Services of Greater Cleveland	8/28/2023	<input type="checkbox"/> 101265
149830	Behavioral Health Services of Greater Cleveland	6/5/2023	<input type="checkbox"/> 101962
155125	Behavioral Health Services of Greater Cleveland	10/9/2023	<input type="checkbox"/> 102006
161563	Behavioral Health Services of Greater Cleveland	1/22/2023	<input type="checkbox"/> 102271
165197	Behavioral Health Services of Greater Cleveland	5/15/2023	<input type="checkbox"/> 102326
166818	Behavioral Health Services of Greater Cleveland	6/15/2023	<input type="checkbox"/> 102535
167998	Behavioral Health Services of Greater Cleveland	8/26/2023	<input type="checkbox"/> 102925
170280	Behavioral Health Services of Greater Cleveland	9/16/2023	<input type="checkbox"/> 103022
17550	Behavioral Health Services of Greater Cleveland	6/15/2023	<input type="checkbox"/> 103162
184626	Behavioral Health Services of Greater Cleveland	7/9/2023	<input type="checkbox"/> 103656
187281	Behavioral Health Services of Greater Cleveland	5/3/2023	<input type="checkbox"/> 103790
22684	Behavioral Health Services of Greater Cleveland	1/31/2023	<input type="checkbox"/> 103932
38004	Behavioral Health Services of Greater Cleveland	1/27/2023	<input type="checkbox"/> 104087
			<input type="checkbox"/> 104192
			<input type="checkbox"/> 104219
			<input type="checkbox"/> 10424
			<input type="checkbox"/> 104390
			<input type="checkbox"/> 104534

# PowerBI Dashboard

## Resource Counts

Category	Resource	Sum of Count
SocialConnections	Neighbor Up - Neighborhood Connections Program	48
PhysicalActivity	CareSource - Fitness Program	35
SocialConnections	Greater Cleveland Volunteers	34
SocialConnections	Behavioral Health Services of Greater Cleveland	31
Stress	The Centers - Behavioral Health Sector	31
PhysicalActivity	Cleveland Fit for Life	29
Stress	University Hospitals - SMART Program	29
Stress	Cleveland Clinic - Wellness & Preventative Medicine Department	28
PhysicalActivity	YMCA of Greater Cleveland	24
FinancialStability	Economic Security Project	20
FinancialStability	Benjamin Rose Institute on Aging - Financial Wellness	17
FinancialStability	United Way	14
Food	Society of St Vincent de Paul Cleveland	12
Food	Greater Cleveland Food Bank	9
Food	Hunger Network of Greater Cleveland	5
Transportation	United Way-Lyft Partnership Program	5
Transportation	Senior Transportation Connection	4
HousingStability	CHN Housing Partners	3
HousingProblems	Step Forward Energy Assistance Programs	2
HousingStability	Neighborhood Alliance	2
HousingStability	The City Mission	2
Transportation	Provide a Ride	2
HousingProblems	Home Repair Resource Center	1
InternetAccess	Affordable Connectivity Program	1
InternetAccess	EmpowerCLE+	1
Education	Cleveland Foundation - Say Yes Cleveland Program	0
Education	College Now Greater Cleveland	0
Education	Education Opportunity Center	0
Employment	Recovery Resources - Employment Assistance Program	0
Employment	Towards Employment	0
Employment	Workforce Opportunity Resource Center	0
<b>Total</b>		<b>389</b>

## Category

- ☐ Education
- ☐ Employment
- ☐ FinancialStability
- ☐ Food
- ☐ HousingProblems
- ☐ HousingStability
- ☐ InternetAccess
- ☐ PersonalSafety
- ☐ PhysicalActivity
- ☐ SocialConnections
- ☐ Stress
- ☐ Transportation

Live demo of match  
creation acting as social  
care coordinator

# Post-Project Thoughts

- Limitation: Cannot fully automate
  - Model doesn't know difference between resources within categories
  - More client info needed to fully match
- Create form that links to database
- Include Education and Employment in scoring system



The background is a dark blue gradient. It is decorated with various geometric elements: thin white vertical lines of varying lengths, small squares in teal, orange, and pink, and larger squares in teal and orange. Some squares are solid, while others are outlines. The text is centered in a white, sans-serif font.

Thank you  
for listening