Pulse of Engagement

Visual Analytics for Economic Health in Engagement, OH

VAST Challenge 2022 – Challenge 3

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Introduction

The Challenge

- Analyze economic health of a fictional city
- Dataset: ∼120 million data points
- 15 months of 5-minute granularity data

Three Questions

1. Business Prosperity
2. Resident Financial Health
3. Employer Health & Turnover

Economic Analysis

Q1: Business

Q2: Residents

Q3: Employers

Our Solution: Pulse of Engagement
Introduction

[SCREENSHOT: Main Dashboard Overview]
Show the tabbed interface with all three question areas

Interactive web application built with **React + D3.js** frontend and **Python Flask** backend

Question 1: Business Prosperity

[PLACEHOLDER FOR THOMAS]

- Which businesses are thriving vs. struggling?
- Revenue trends over time
- Market share evolution

[**SCREENSHOT: Business Visualizations**]

[PLACEHOLDER FOR THOMAS]

Prosperous Businesses   **Struggling Businesses**

eammate   To be filled by teammate

Question 2: Resident Financial Health

Q2: Analysis Approach

Question 2: Resident Financial Health

Three Complementary Lenses

Geographic

- Building heatmap
- Savings by location
- Identify red zones

Demographic

- Wage vs. cost
- K-Means clustering
- Savings drivers

Trajectories

- Income vs. expenses
- Inequality trends
- Time evolution
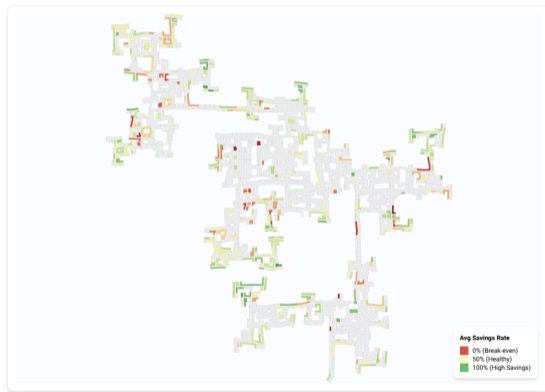
Geographic Financial Health
Question 2: Resident Financial Health

Building-Level Heatmap

- Colors by average savings rate
- Red: break-even or negative
- Yellow: moderate savings
- Green: high savings

Insights

- "Red pockets" persist over time
- Chronic, not worsening, conditions
- Mini-clusters suggest local stressors

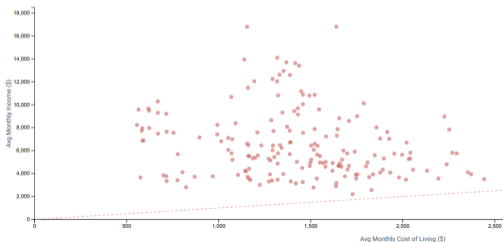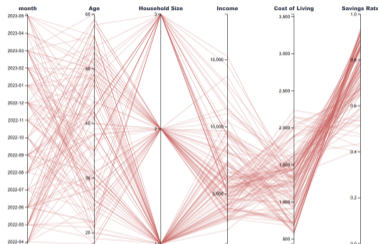# Resident Profile: Affluent Achievers
Question 2: Resident Financial Health

Affluent Achievers

Main Characteristics

- High income levels
- Predominantly graduate education
- Significant financial buffer

Median Statistics (Apr 2022)

- **Income:** $5,756
- **Cost:** $1,419
- **Savings:** 76.6%

Resident Profile: Stretched Households
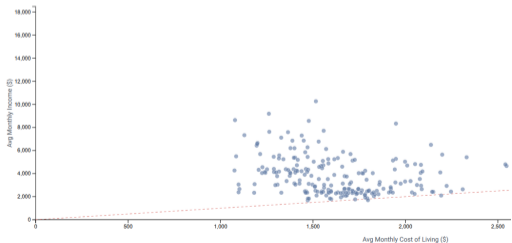
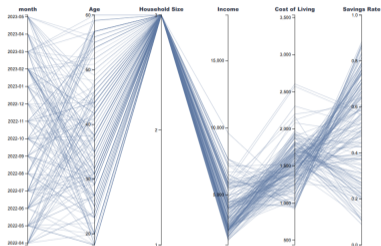Question 2: Resident Financial Health

Stretched Households

Main Characteristics

- Larger households, often with children
- Tightest budget constraints
- "Living Gap" pressure is highest here

Median Statistics (Apr 2022)

- **Income:** $2,869
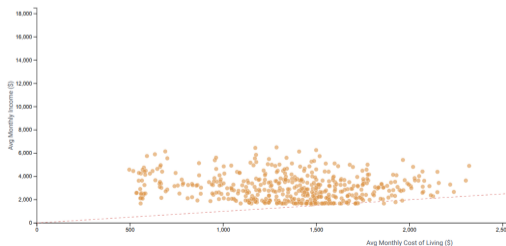- **Cost:** $1,405
- **Savings:** 51.0%

Lean Savers

Main Characteristics

- Smaller households
- Typically without children
- Moderate income, but lower costs than families

Median Statistics (Apr 2022)

- **Income:** $3,352
- **Cost:** $1,586
- **Savings:** 54.5%

What Drives Savings?
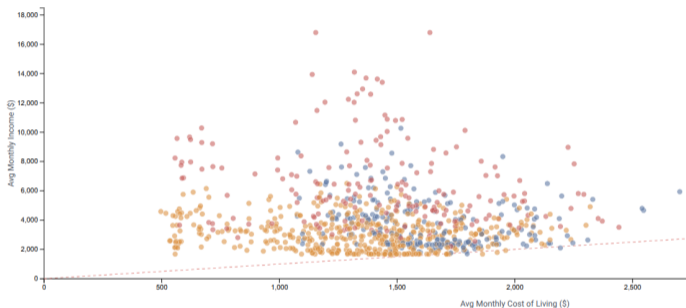
Question 2: Resident Financial Health

Demographic Drivers

Savings rate predictors (ΔR^2)

- Cost of living (0.828)
- Income (0.408)
- Household size (0.376)
- Has kids (0.127)

Cluster separators (η^2)

- Has kids (83.1%)
- Graduate education (72.0%)
- Household size (61.9%)
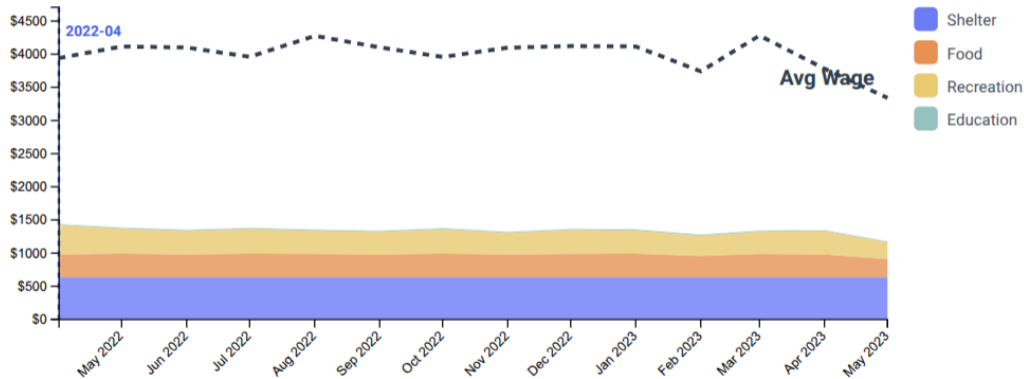- Income (38.0%)

Income & Savings Inequality Over Time

Inequality Trends

- Gini coefficient tracks disparity
- Income inequality stable over time
- Savings inequality slightly higher

Expense Dynamics Over Time

Question 2: Resident Financial Health

Question 3: Employer Health

[PLACEHOLDER FOR MICHAL]

- Employment patterns across the city
- Turnover rate analysis
- High/low turnover areas

[SCREENSHOT: Employer Visualizations]

[PLACEHOLDER FOR MICHAL]

Healthy Employers   **High Turnover Areas**

eammate   To be filled by teammate

Design Decisions
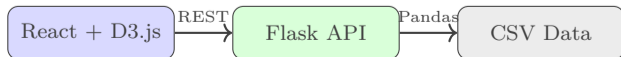
Tech Stack
Design Decisions

Frontend

- **React 18** – Component architecture
- **D3.js v7** – Visualization rendering
- **TailwindCSS** – Styling
- **Axios** – API communication

Infrastructure

- **Docker Compose** – Orchestration
- **Nginx** – Reverse proxy

Backend

- **Python 3.11** – Core language
- **Flask** – REST API
- **Pandas/NumPy** – Data processing
- **Scikit-learn** – K-Means clustering
- **Pytest** – Testing

React + D3.js → REST → Flask API → Pandas → CSV Data

Team Organization

Division of Work

- One question per team member
- Shared infrastructure setup
- Code reviews via Git

Thomas	Q1: Business Prosperity
Jan	Q2: Resident Financial Health
Michal	Q3: Employer Health

Shared Components

- Docker infrastructure
- API structure
- Test framework

Communication

- Regular syncs and feedback
- Clear API contracts

Lessons Learned

What Worked Well

- ✔ Docker for reproducibility
- ✔ Clear question separation
- ✔ Caching for large datasets
- ✔ Test-driven development

Challenges

- ✖ TODO

Would Do Differently

- TODO

Thank You!

Questions?

Thomas Gantz	Jan Marxen	Michal Sterzel
Q1: Business	Q2: Residents	Q3: Employers

 github.com/janmarxen/VAST-challenge