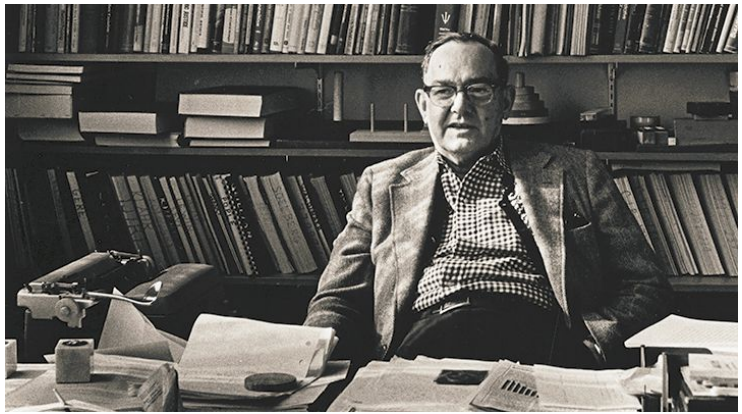
Comprehensive Planning & Data Science



“All behavior involves conscious or unconscious selection of particular actions out of all those which are physically possible to the actor and to those persons over whom he exercises influence and authority.”
— Herbert A. Simon, Administrative Behavior, 4th Edition: A Study of Decision-making Processes in Administrative Organisations

Agenda

1. Homework questions, Review

2.What is comprehensive planning?

3. How comprehensive planners fail with forecasting

4. From comprehensive to strategic planning

5. Case Studies:
    A. Bike share planning in Philadelphia
    B. Lancaster Urban Growth Area

Homework Questions?

Review

1. What makes a good indicator?
2. Spatial process is important - what was the spatial process associated with TOD in Philadelphia?
3. Working with census data, longitudinal data

What is comprehensive planning?

Comprehensive Planning

1. Sometimes required by law
2. Goal-driven
3. Assess current conditions
4. Large geography
5. Lots of public input
6. Comprehensive across domains
7. **Forecast** 10 - 30 years out
8. Data-driven
9. Scenario-driven (ie. evaluating alternatives)
10. Monitor the plan

https://www.phila2035.org/

How comprehensive planners fail with forecasting..
An exercise

Comprehensive Planning & Forecasting

“Let’s plan for _____ in 20 years…”

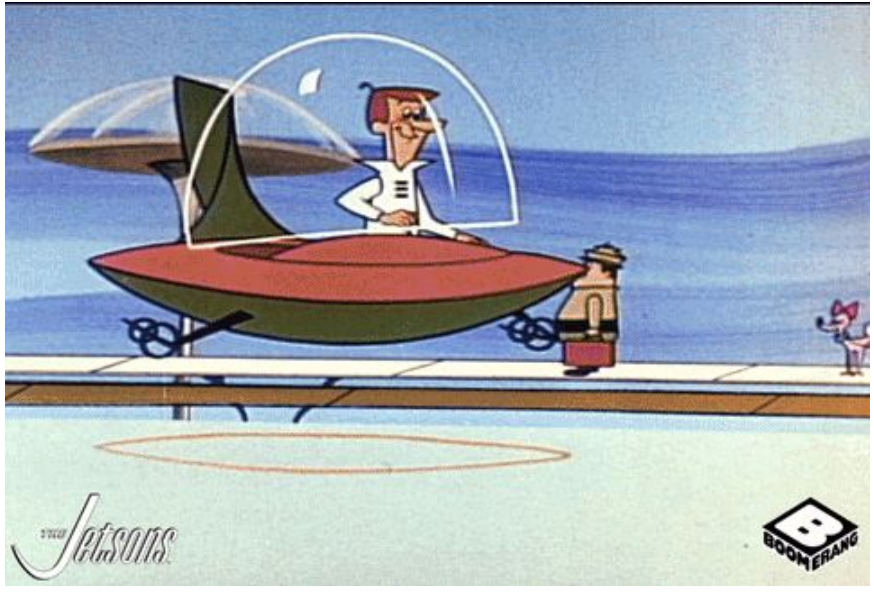
Comprehensive Planning & Forecasting

Transportation

What trends today could we never have forecasted in 2001?

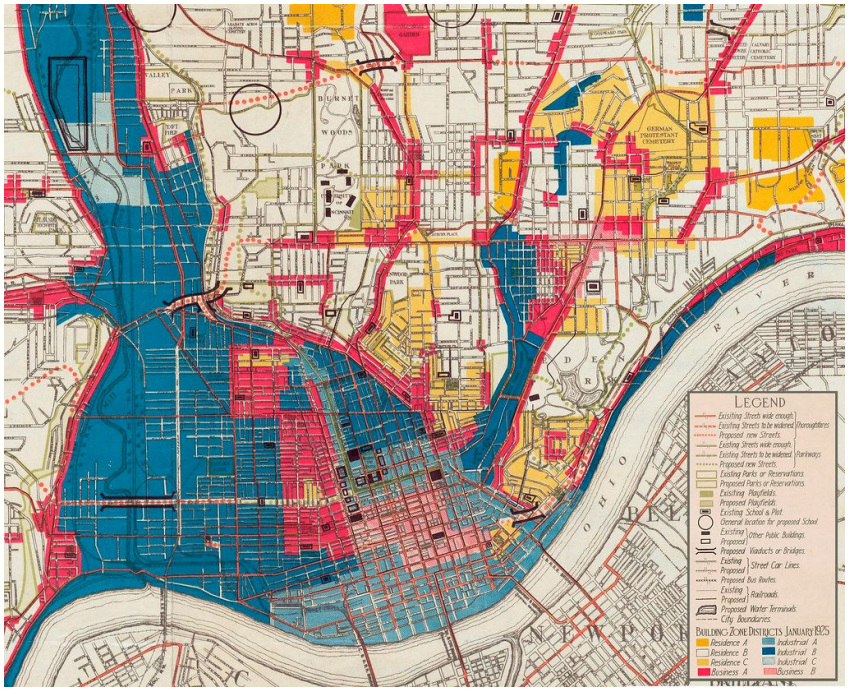
Comprehensive Planning & Forecasting

What **transportation** trends do you think are going to be important in 2041?



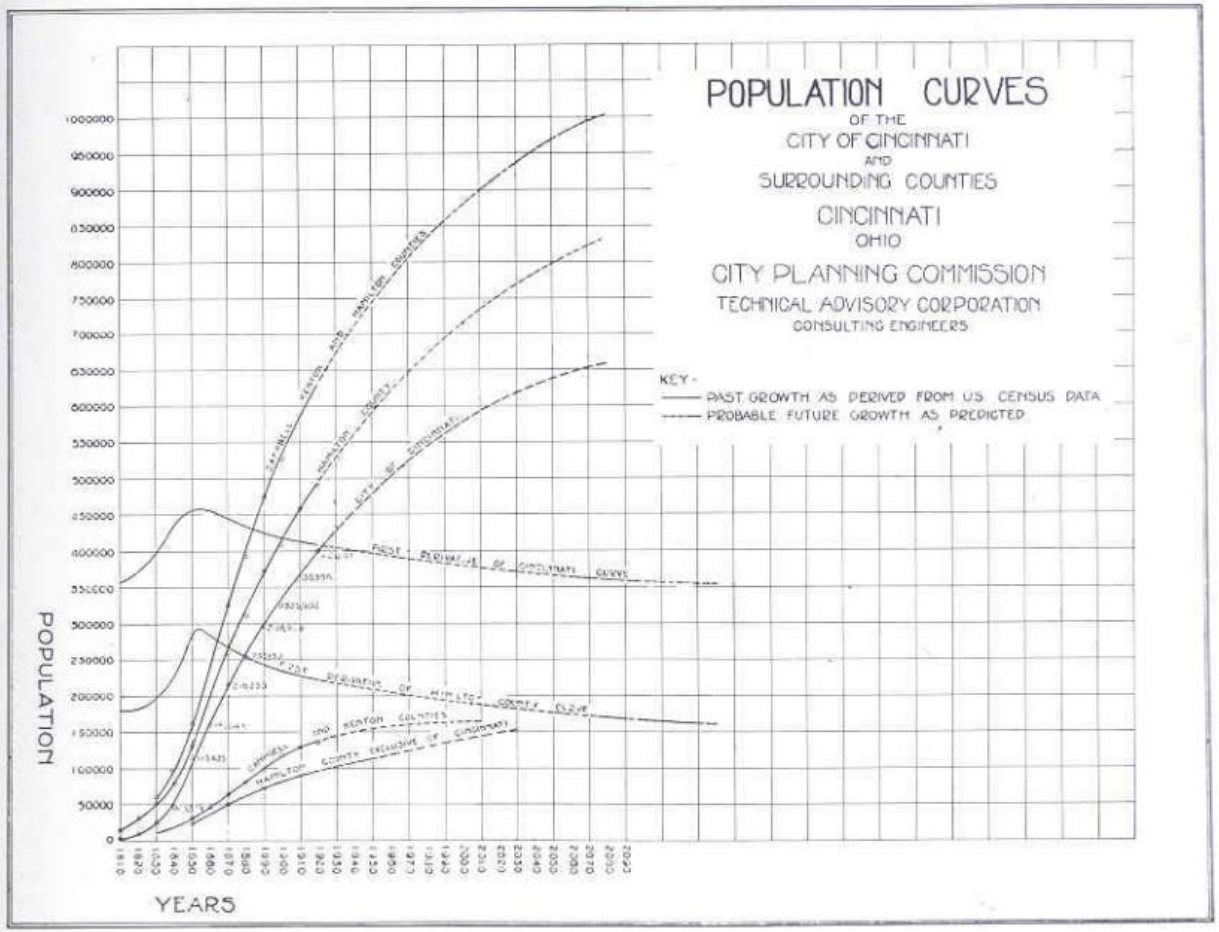
Me: You can’t plan for an uncertain future, when future changes will be transformational

Planners: *Hold my beer*

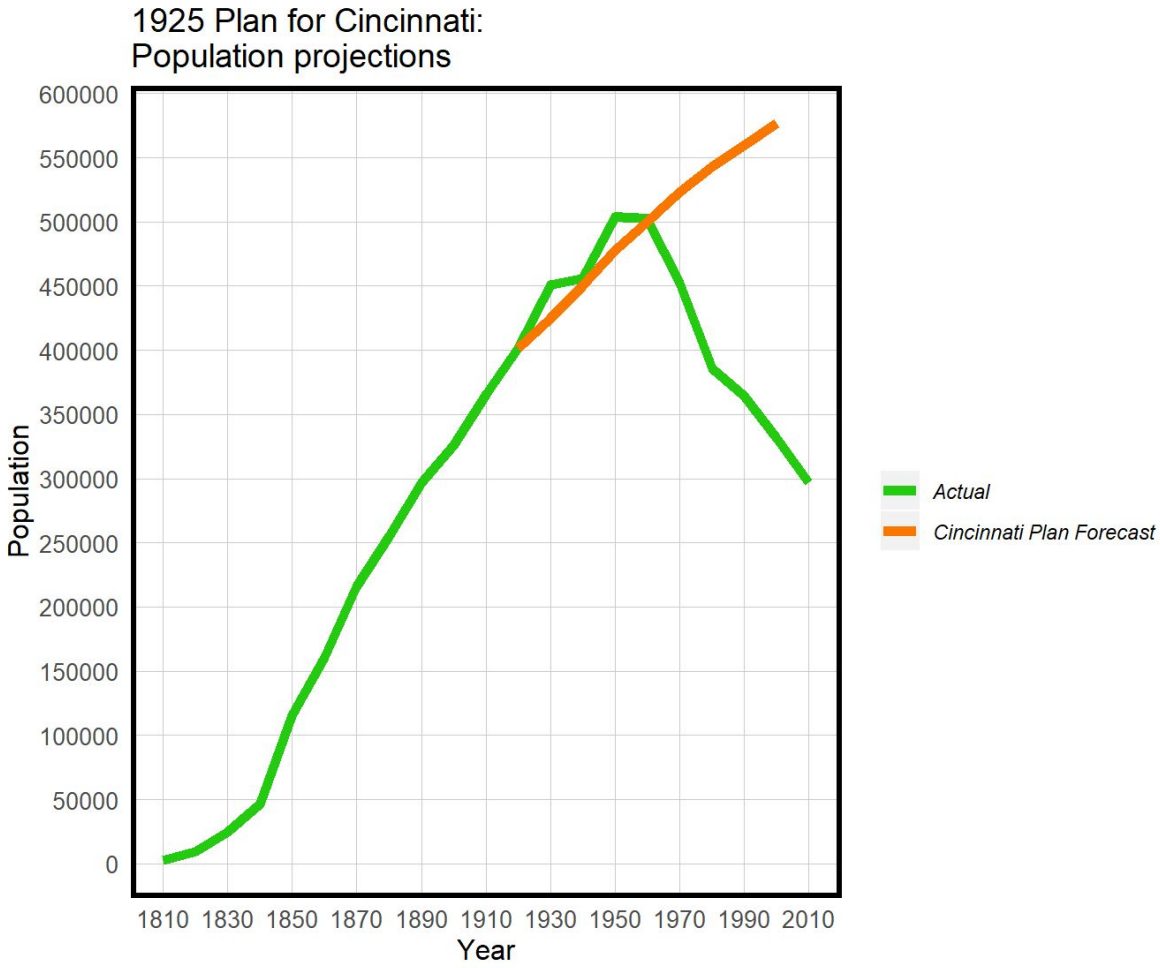


Method of Calculating Growth of Population

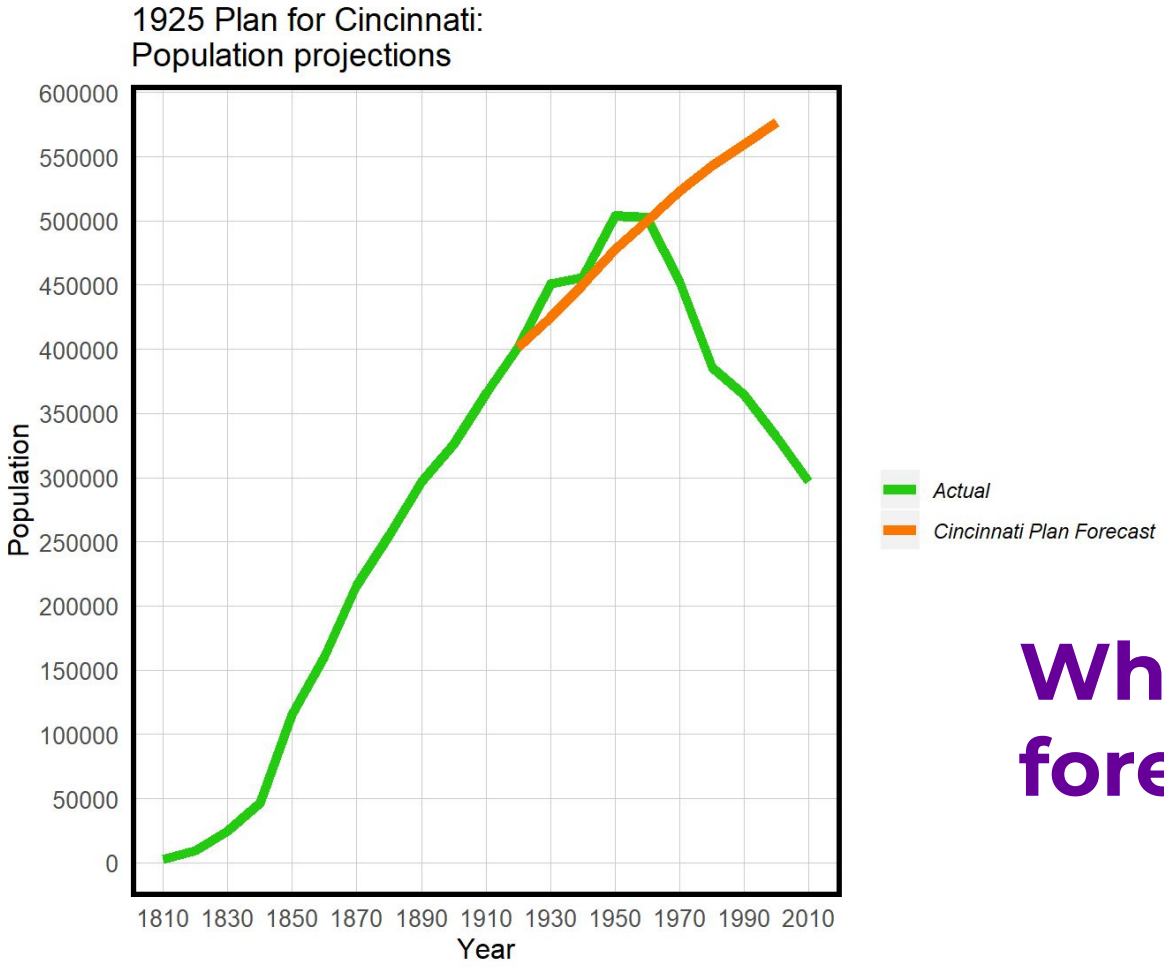
The population of a city as at present distributed, and as it will grow and be distributed in the future, is obviously the basis upon which scientific city planning must be formulated. Therefore, careful studies were made of the probable total future population of Cincinnati as a first essential of the Plan.



The growth of this city is slowing down.



Public Policy Analytics, Figure 6.1



Public Policy Analytics, Figure 6.1

Why did the forecast fail?

The forecast failed because there is no reason to expect that ‘current conditions’ will generalize to the future.

What ‘systems’ would we need to understand in order to reasonably forecast population into the future?

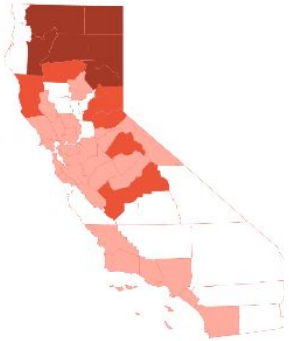
The New York Times Magazine

HOW CLIMATE MIGRATION WILL RESHAPE AMERICA

Millions will be displaced. Where will they go?

The New York Times Magazine

By 2070, some 28 million people across the country could face Manhattan-size megafires. In Northern California, they could become an annual event.



A megafire on average every …

- 1-2 years
- 2-5 years
- 5+ years
- No data

*High Emissions scenario

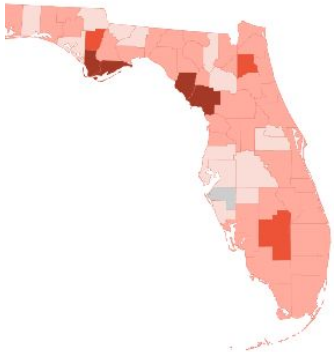
Sea-level rise could displace as many as 13 million coastal residents by 2060, including 290,000 people in North Carolina.

Percent of properties below high tide …

- 5-25%
- 1-5%
- Under 1%
- 0

*High Emissions scenario

By 2060 in Florida and elsewhere, the costs of sea-level rise and hurricanes will be compounded by knock-on economic challenges, from growing crime to falling productivity.

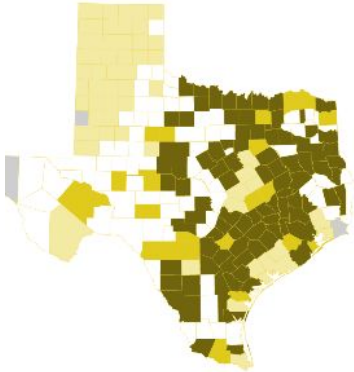


Economic damages as a proportion of G.D.P. …

- 10%-55%
- 5-10%
- 1-5%
- 0-1%
- Economic benefits

*High Emissions scenario

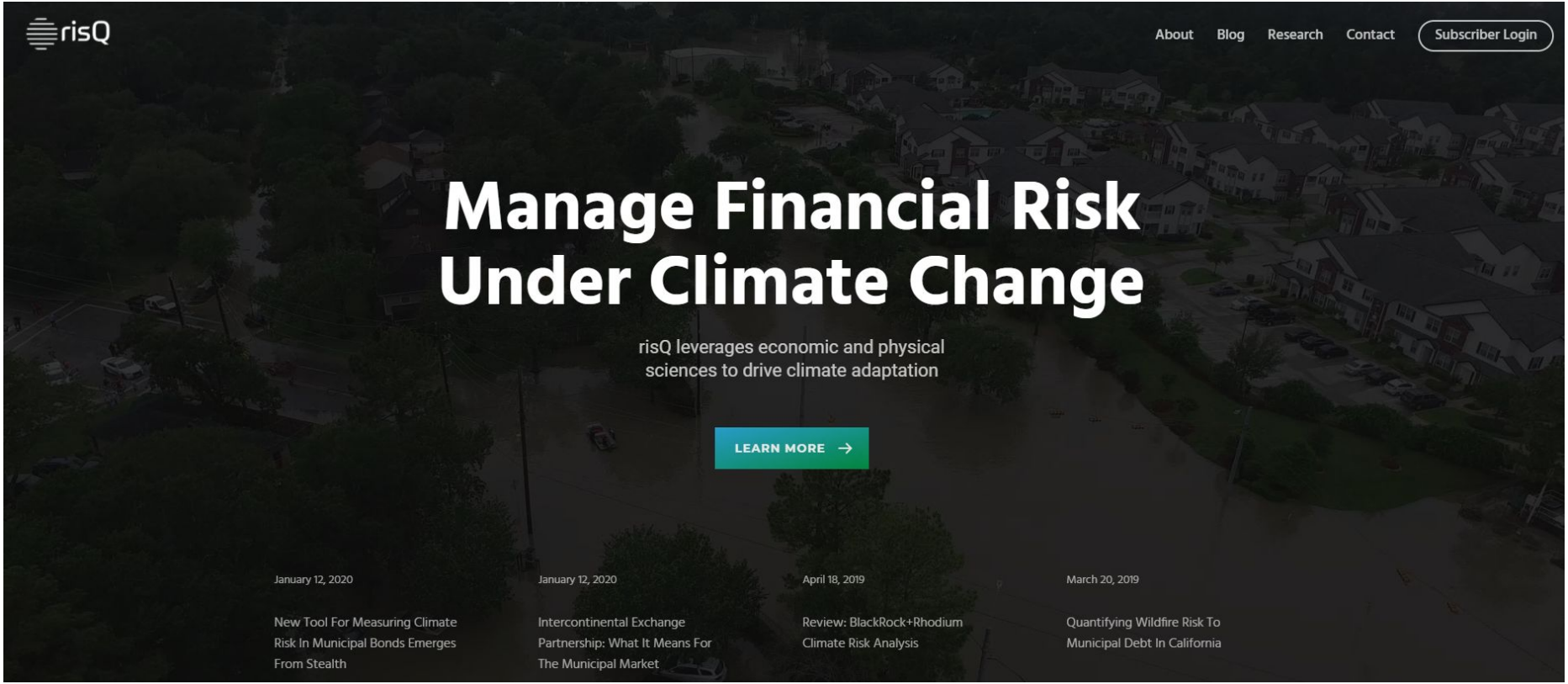
Corn and soy production will decrease with every degree of warming. By 2060, parts of Texas may experience a drop in yields of more than 92 percent.



Crop yield decline by:

- 60-92%
- 30-60%
- 0-30%
- Yield increases
- No data

*High Emissions scenario


risQ
About
Blog
Research
Contact
Subscriber Login
Manage Financial Risk Under Climate Change
risQ leverages economic and physical sciences to drive climate adaptation
LEARN MORE
January 12, 2020
New Tool For Measuring Climate Risk In Municipal Bonds Emerges From Stealth
January 12, 2020
Intercontinental Exchange Partnership: What It Means For The Municipal Market
April 18, 2019
Review: BlackRock+Rhodium Climate Risk Analysis
March 20, 2019
Quantifying Wildfire Risk To Municipal Debt In California

Comprehensive Planning vs Strategic Planning

Comprehensive Planning

1. Sometimes required by law
2. Goal-driven
3. Assess current conditions
4. Large geography
5. Lots of public input
6. Comprehensive across domains
7. Forecast 10 - 30 years out
8. Data-driven
9. Scenario-driven (ie. evaluating alternatives)
10. Monitor the plan

Strategic Planning

1. Driven by internal stakeholders
2. Goal-driven
3. Assess current decision-making process
4. Small or large geography
5. May involve no public input
6. Specific to a single domain
7. Near term (or time independent) is better
8. Data-driven
9. Scenario-driven (ie. evaluating alternatives)
10. Monitor the plan with high resolution time/space indicators.

https://www.phila.gov/programs/philly-tree-plan/

An official website of the City of Philadelphia government Here's how you know | Office of the Mayor | City government directory

City of Philadelphia

SERVICES | PROGRAMS & INITIATIVES | NEWS & EVENTS | PUBLICATIONS & FORMS

COVID-19: Learn how to stay safe, get vaccinated, and find testing. Visit phila.gov/covid.

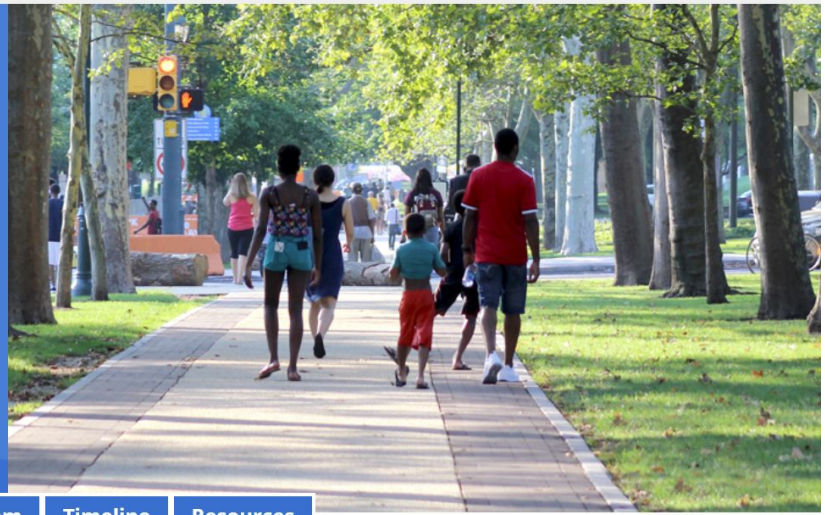
Election day is Nov. 8, 2022
Check your voter status, apply for a mail-in ballot, and more.

MAKE A PLAN TO VOTE

Philly Tree Plan

Creating a ten-year plan for the growth and care of Philadelphia's urban forest.

FIND YOUR PATH PHILADELPHIA PARKS & RECREATION



Home | Vision | Our team | Timeline | Resources

Forecasting - use the right tool for the job

https://palakagr.github.io/MUSAPracticum/#

Use case 1: Predicting bike share demand in Philadelphia

IndeGo bike share system - what do they need to know to launch their network?

Goals - create an efficient and cost-effective transit alternative, enhance transit equity... what else?

Strategy - put the stations and the bikes in the right places to optimize goal-related outcomes

Use case 1: Predicting bike share demand in Philadelphia

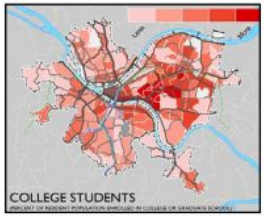
In cities with bike share systems, are ridership patterns sufficiently general enough that they can be used to predict bike share usage in cities without such systems?

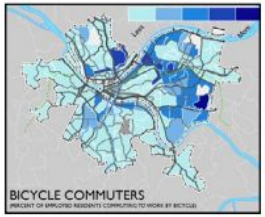
Take data from These bike share Systems, and predict for…

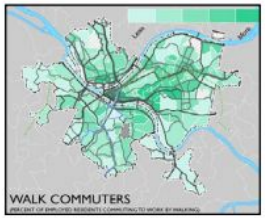
Philadelphia

This was in 2013, nearly a year before the Indego system debuted.

What was the ‘business as usual’ approach to bike share planning?







GIS analysis maps for the Bike Share Study, Pittsburgh, PA

LOCAL CONTEXT ANALYSIS

Alta uses GIS and census data to map the demographics of a community, such as household income, vehicle ownership, bicycle and pedestrian commuters, employment centers, parks, greenways, and key destinations. Individual maps are overlaid to form a composite heat map that shows where demand for bike share is likely to be highest.

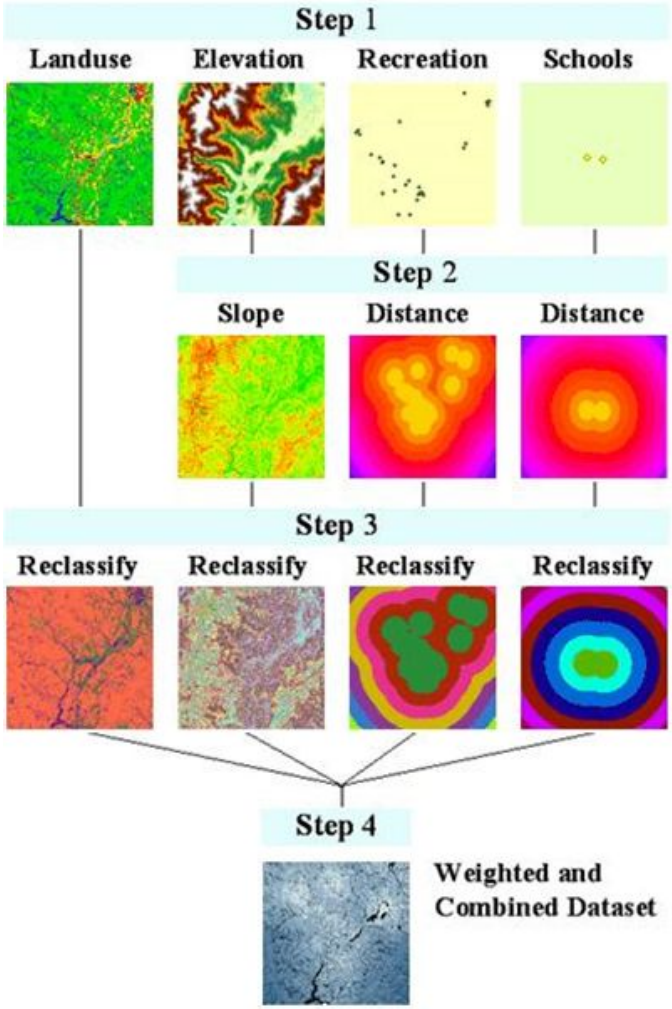
SYSTEM SIZE, DEMAND, AND STATION LOCATIONS

Alta's heat maps show areas that are well-suited for bike share, and are used to make recommendations for system size and service area. Alta also uses GIS data to create analysis maps focused on bike share system equity.

BUSINESS PLAN, EXPECTED COSTS AND REVENUE, AND OPERATING MODEL

Our business plans define expected system costs and develop diversified funding strategies for dock-based, smart-lock, and hybrid bike share systems. We explore all avenues of potential revenue, including user fees, sponsorship opportunities, and public and private funding. Our plans generate interest in bike share with decision makers, potential sponsors, and the general public.

https://altaplanning.com/wp-content/uploads/Bike-Share-Planning-and-Design.pdf


Step 1
Landuse
Elevation
Recreation
Schools
Step 2
Slope
Distance
Distance
Step 3
Reclassify
Reclassify
Reclassify
Reclassify
Step 4
Weighted and
Combined Dataset

Weighted raster ‘composite’ approach:

- **Pros:** Expowers experts with domain experience. Let the domain expert ‘set the weights’.

- **Cons:** Experts have been known to be wrong.

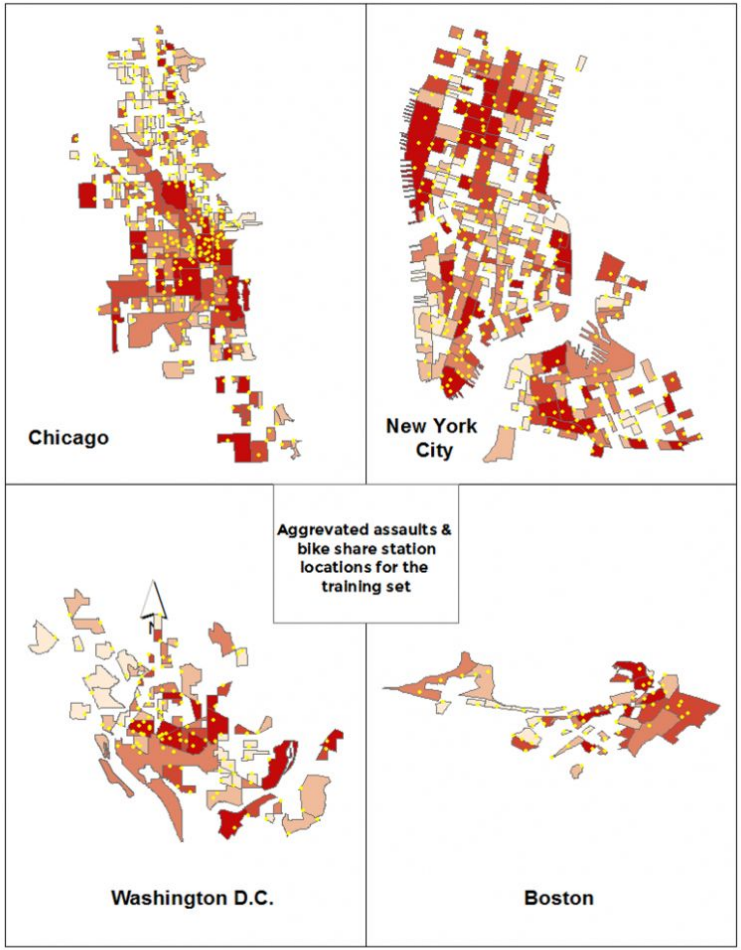
The machine learning approach

- **Pros:** Gather ridership from a sample of cities similar to the one being planned as well as other exogenous data. In effect, have the weights set by the data or the experience from the sample cities.

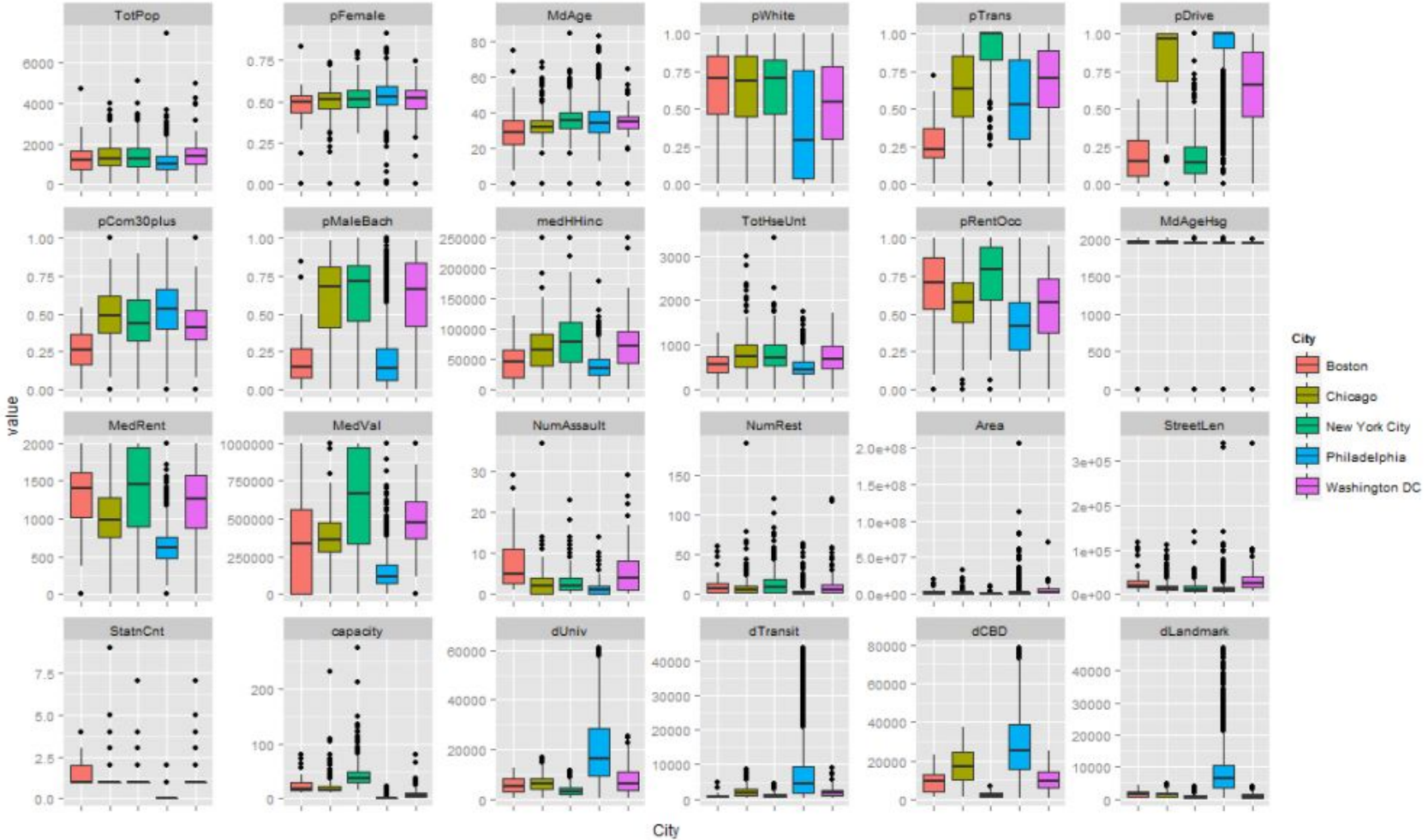
- **Cons:** What if there isn’t enough training data?

Gather data (features) from the training set cities

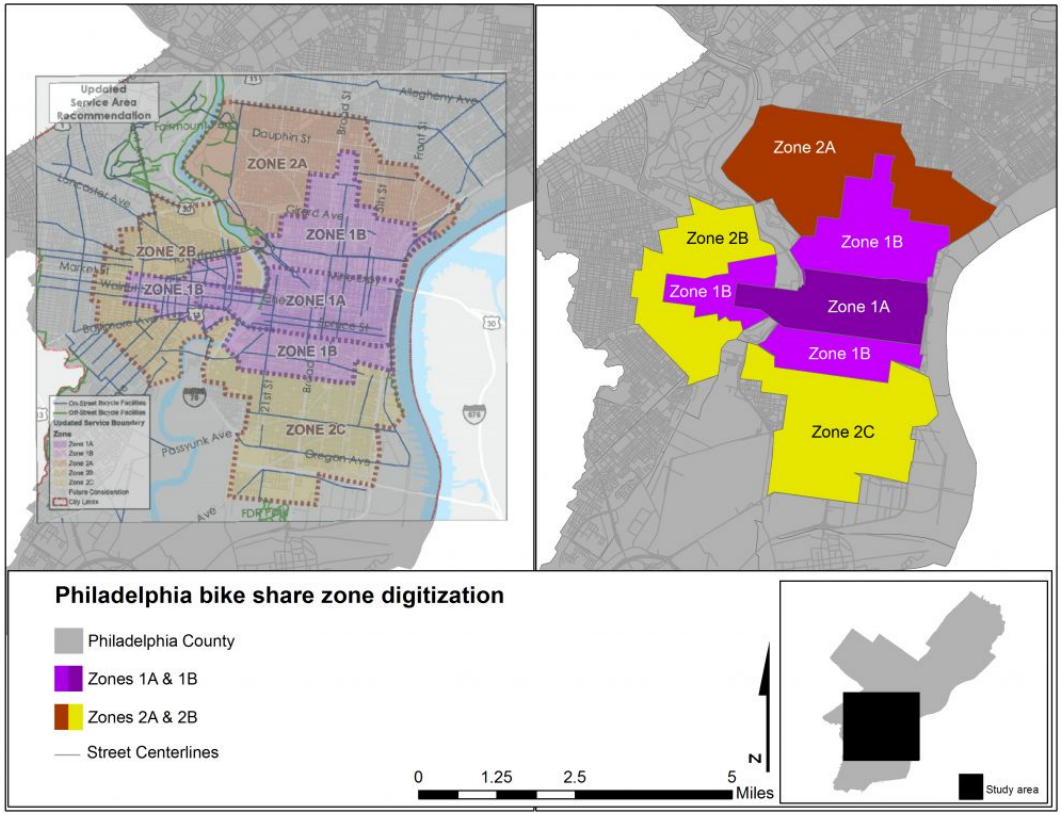
	Variable	Description	Alternative Source*
Demographic (ACS)	TotPop	Total population	
	pFemale	Percent female	
	MdAge	Median age	
	pWhite	Percent white	
	pTrans	Percent who take transit to work	
	pDrive	Percent who drive	
	pCom30plus	Percent who commute 30+ minutes	
	pMaleBach	Percent of males with a bachelor degree	
	medHHinc	Median household income	
	TotHseUnt	Total housing units	
	pRentOcc	Percent Renter Occupied	
	MdAgeHsg	Median Age of Housing	
	MedRent	Median Rent	
	MedValue	Median House Value	
Built Environment	dLandmark	Distance to nearest Landmark	Washington D.C.: Geocommons.com
	dTransit	Distance to nearest transit station	
	dCBD	Distance to CBD	New York City: John Weir, GitHub
	dUniv	Distance to nearest University w/ > 10k student enrollement	Nat. Center Educ. Stat.: Geocommons
	NumAssault	Number of assault crimes	New York City: Thomas Levine)
	NumRest	Number of full service restaurants	ESRI Business Analyst Extension
	StreetLen	Total length of streets in feet	
	Area	Total area of block group in sq. feet	
Bike	capacity	Number of bikes/station	
	StatnCnt	Count of bike share stations	
	strtTrip	Number of bike share departures	



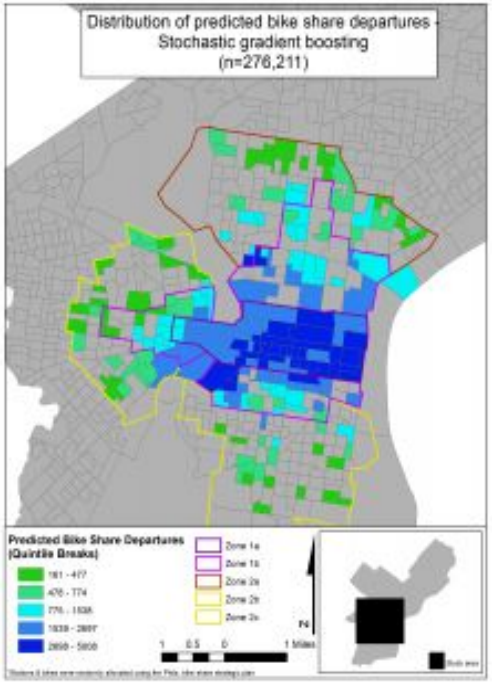
Do the training set features generalize to Philly?

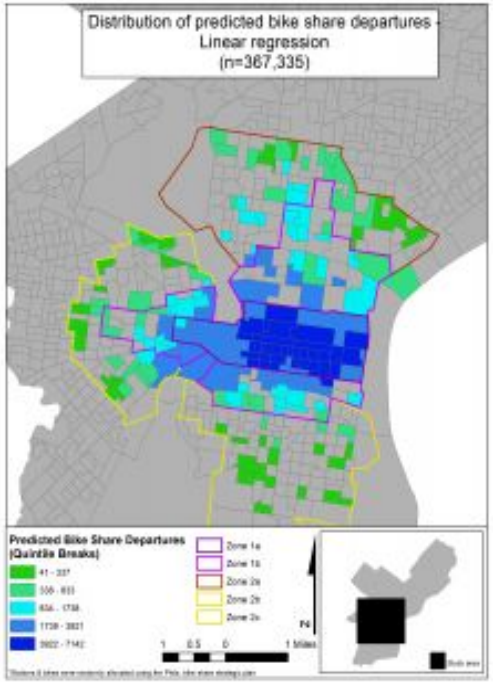


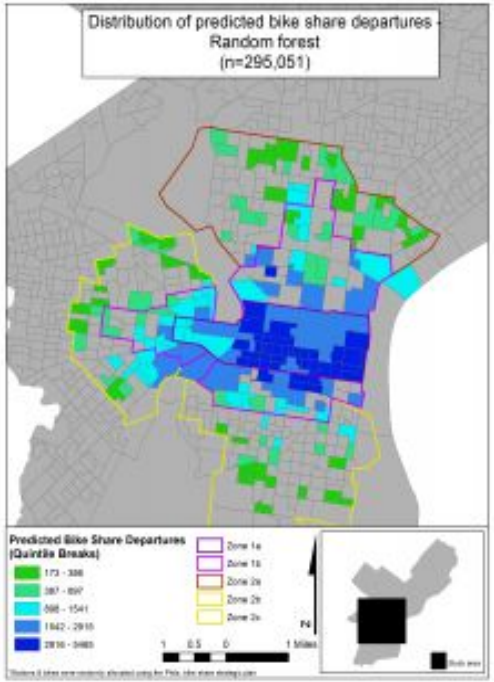
How do we figure (supply-side) inputs to the model - namely the location of would-be stations?



Model type	OLS	Random Forest	Gradient Boosting
# of predicted trips	367,355	295,051	267,211



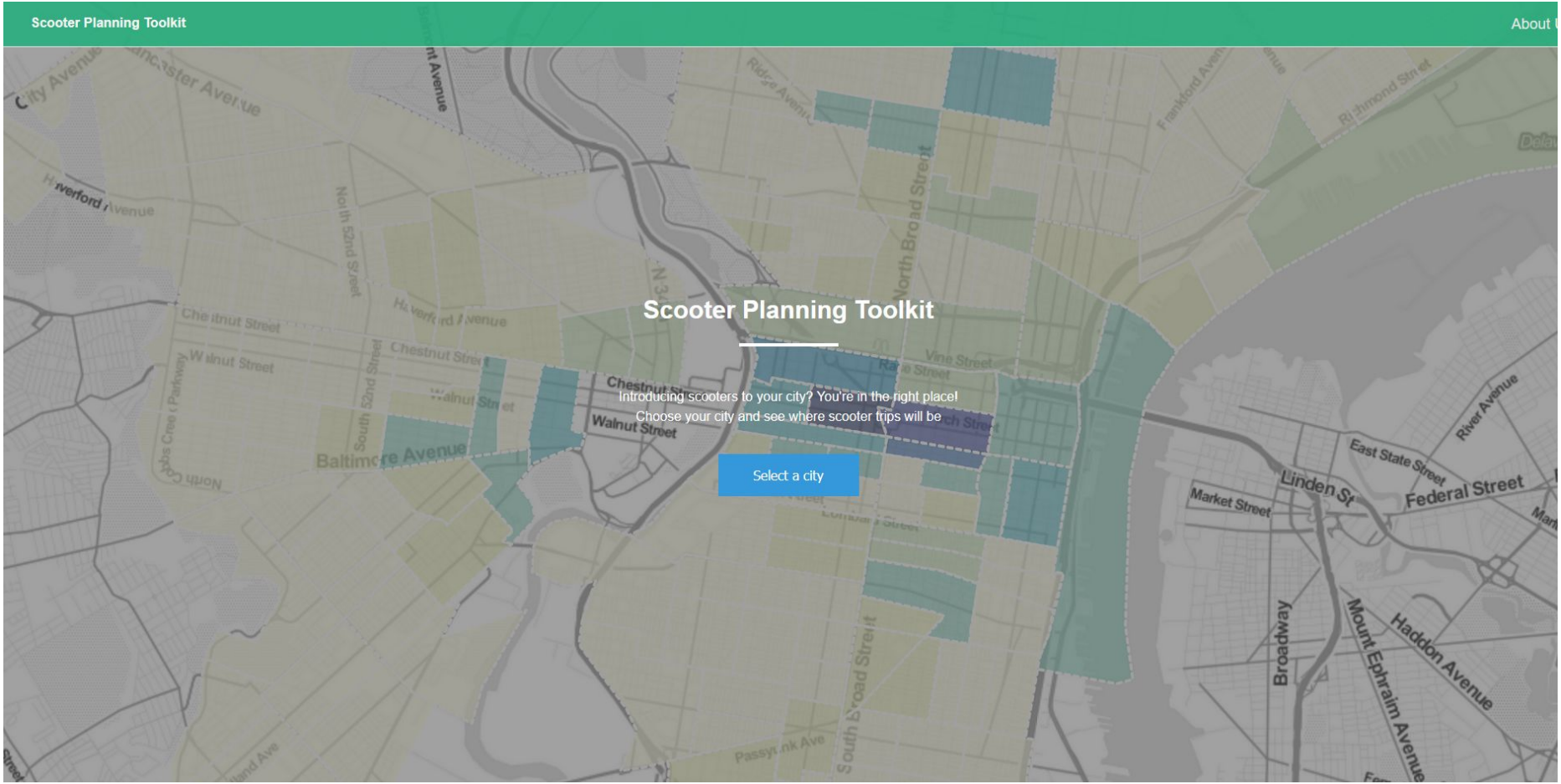




This model predicted 267,211 trips in the first 4 months of Philadelphia's bike share system.

This is **just 17% more** trips than actually occurred in the first four months of service.

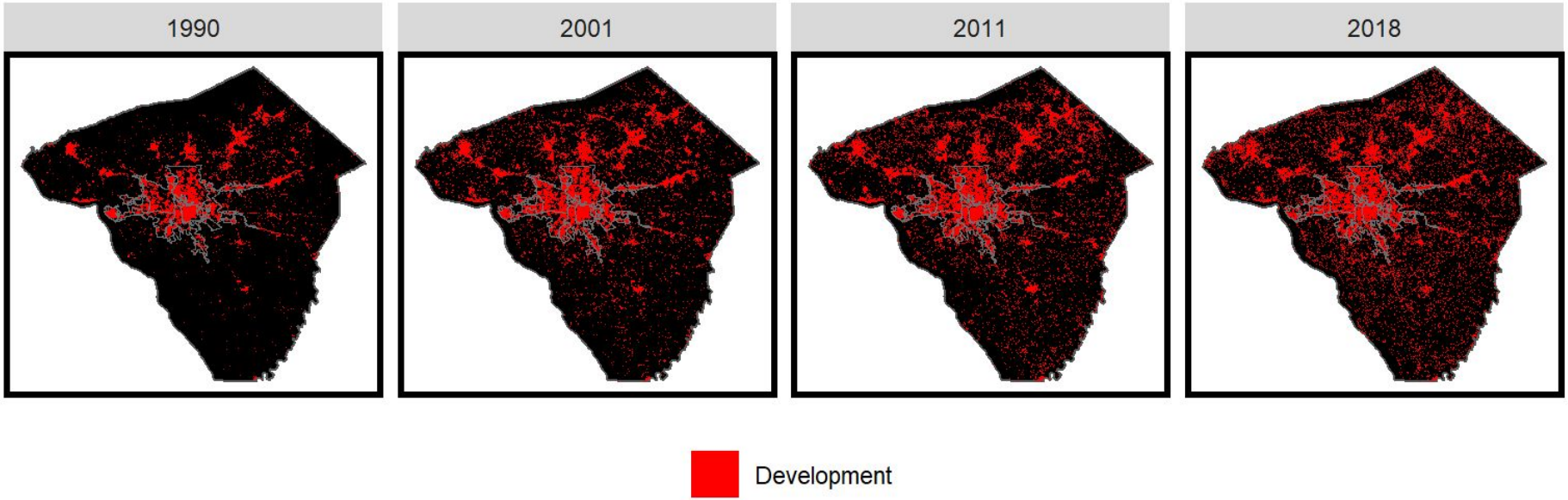
*Can we **democratize** the planning process by placing these empirical tools into the hands of smaller communities for free to help them plan their own systems*


Scooter Planning Toolkit
Introducing scooters to your city? You're in the right place!
Choose your city and see where scooter trips will be
Select a city

Growth Planning Use Case: Where should we extend the Urban Growth Area in Lancaster, PA?

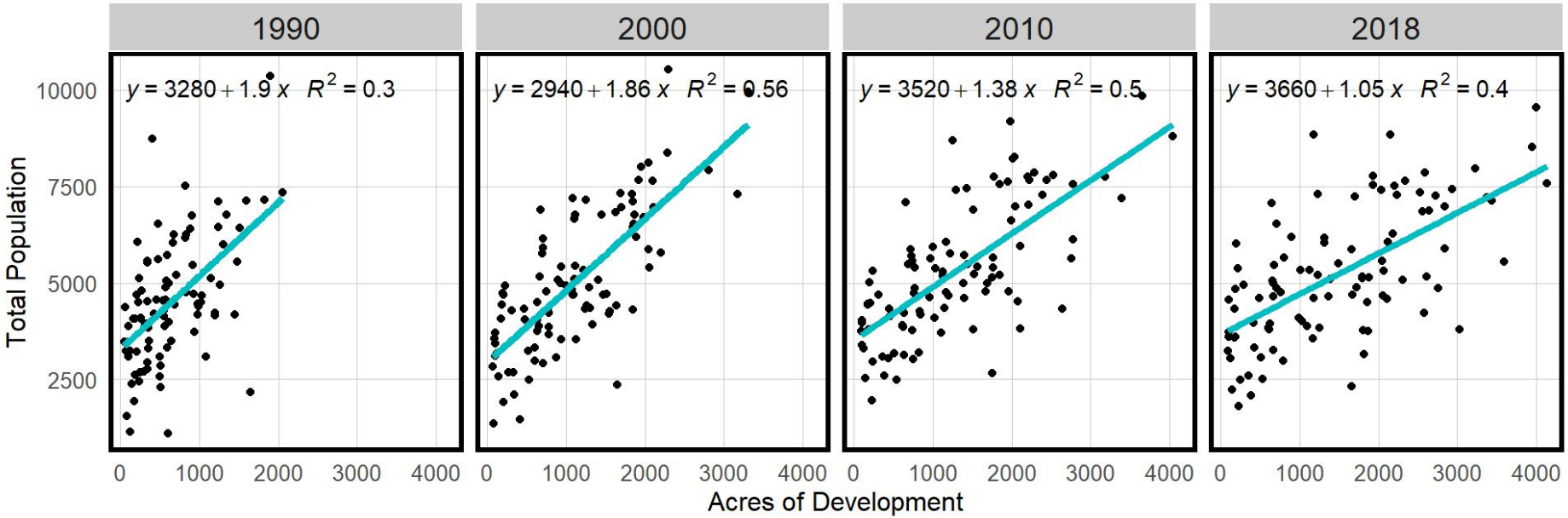
Land Cover Change - Lancaster, PA - 1990 - 2018

Author's estimations via supervised classification. Source: USGS

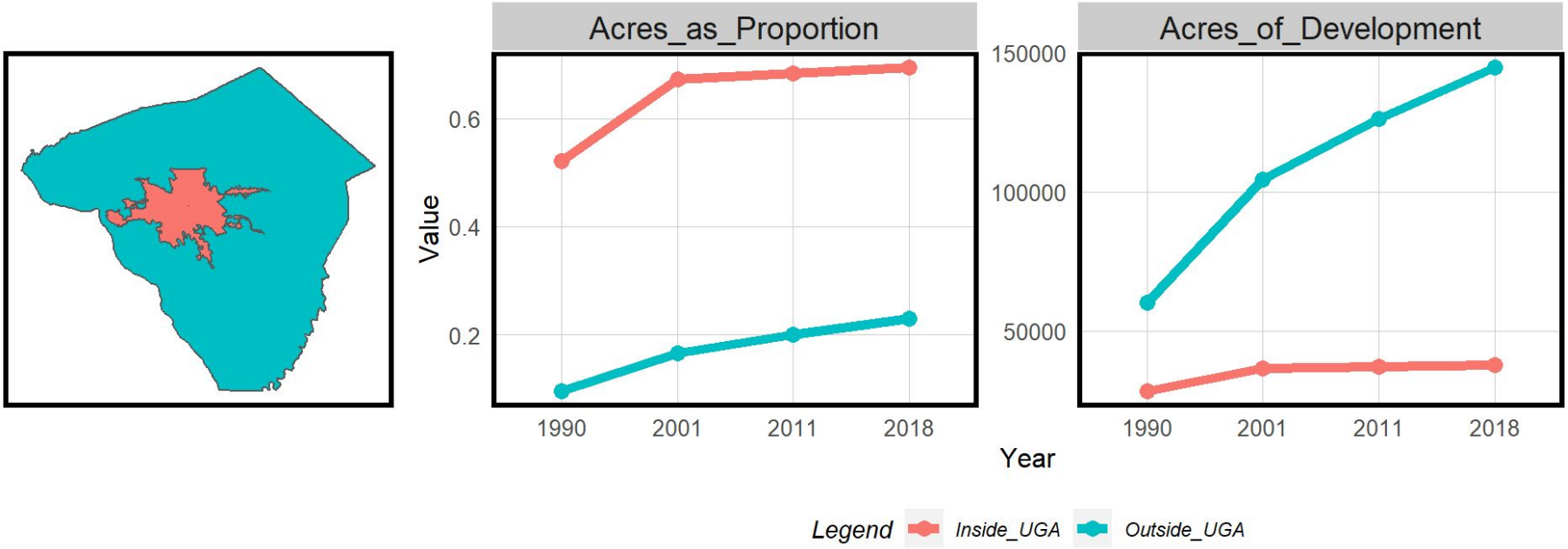


Total Population as a function of Urban Development

Lancaster, PA; Census Tracts; 1990 - 2018.



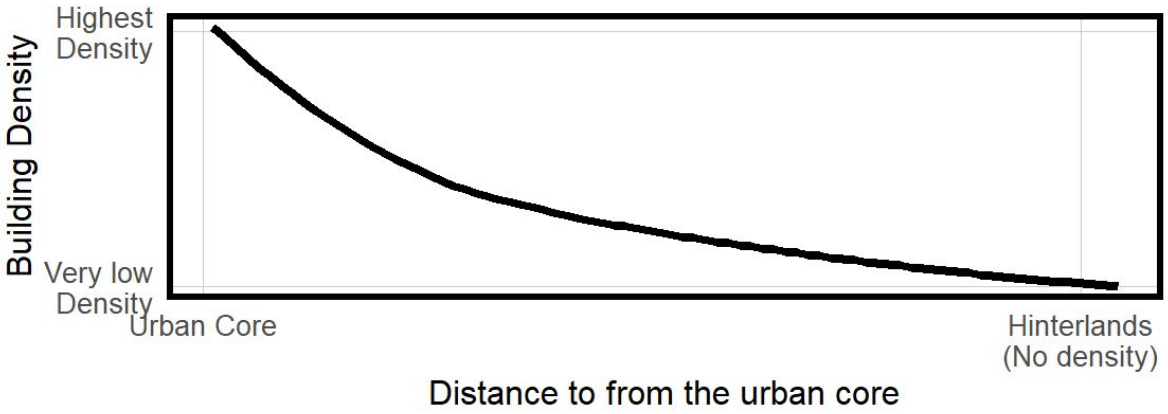
Growth inside & outside of the UGA



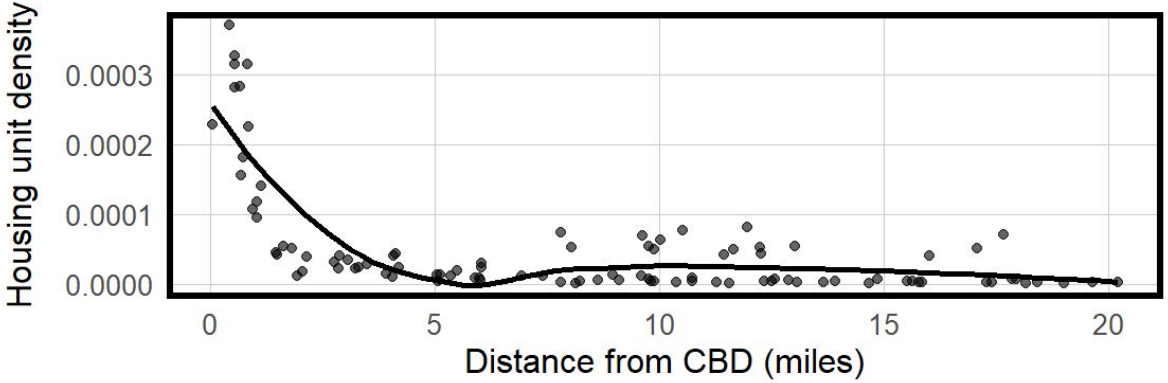
Bid-Rent Theory

Von Thunen (1826), Alonso (1964)

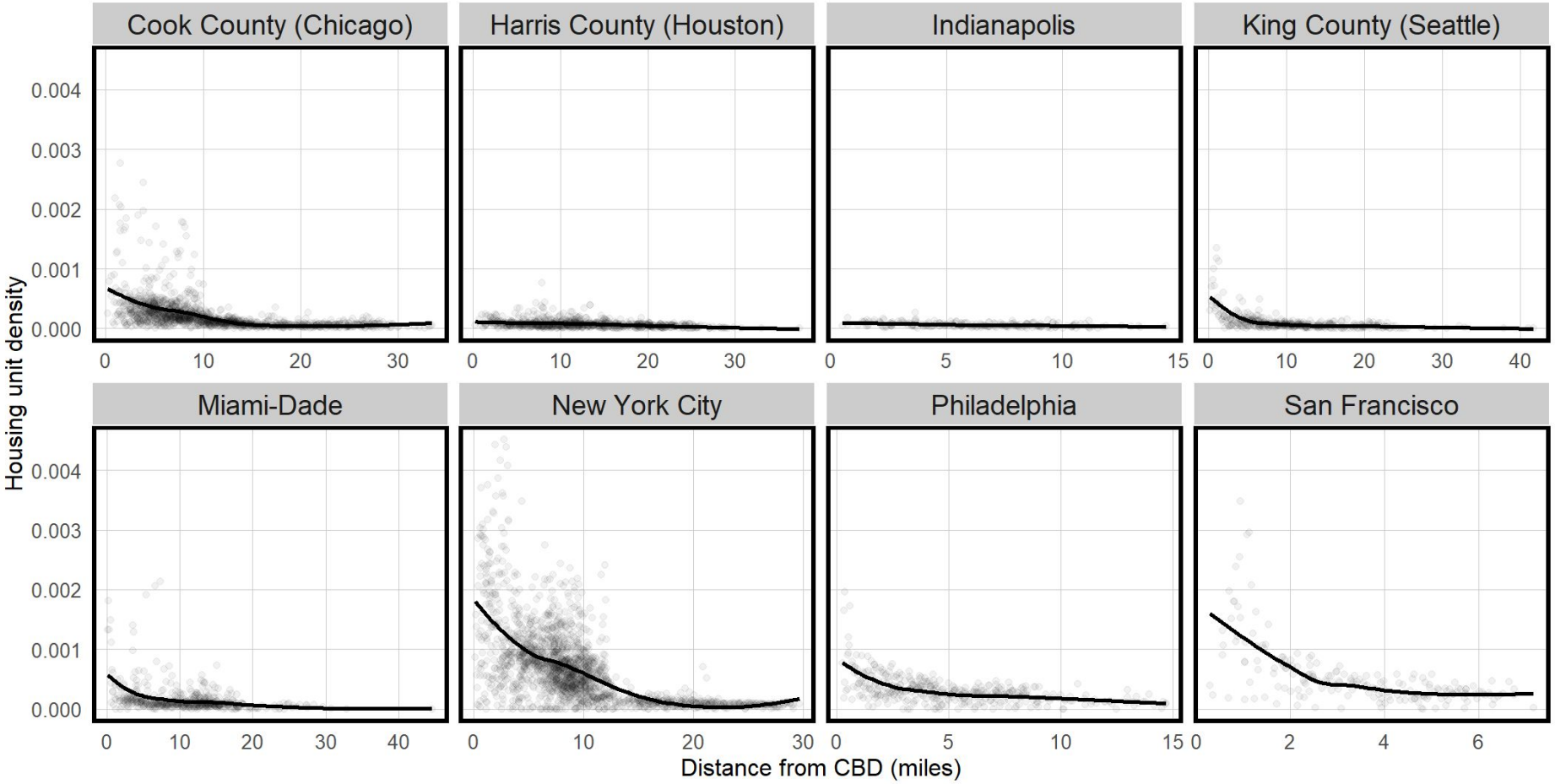
Bid Rent Curve



Lancaster bid-rent

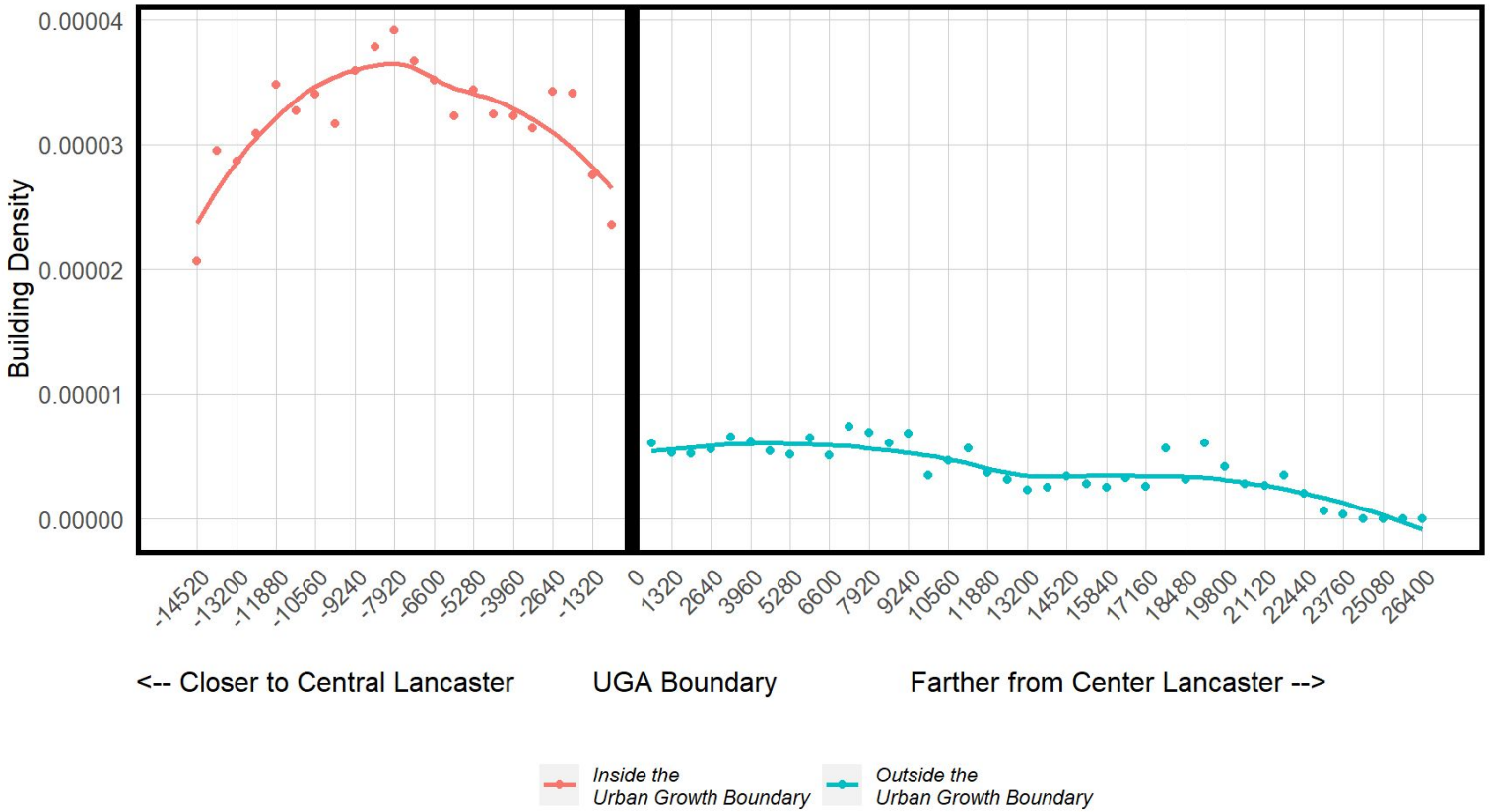


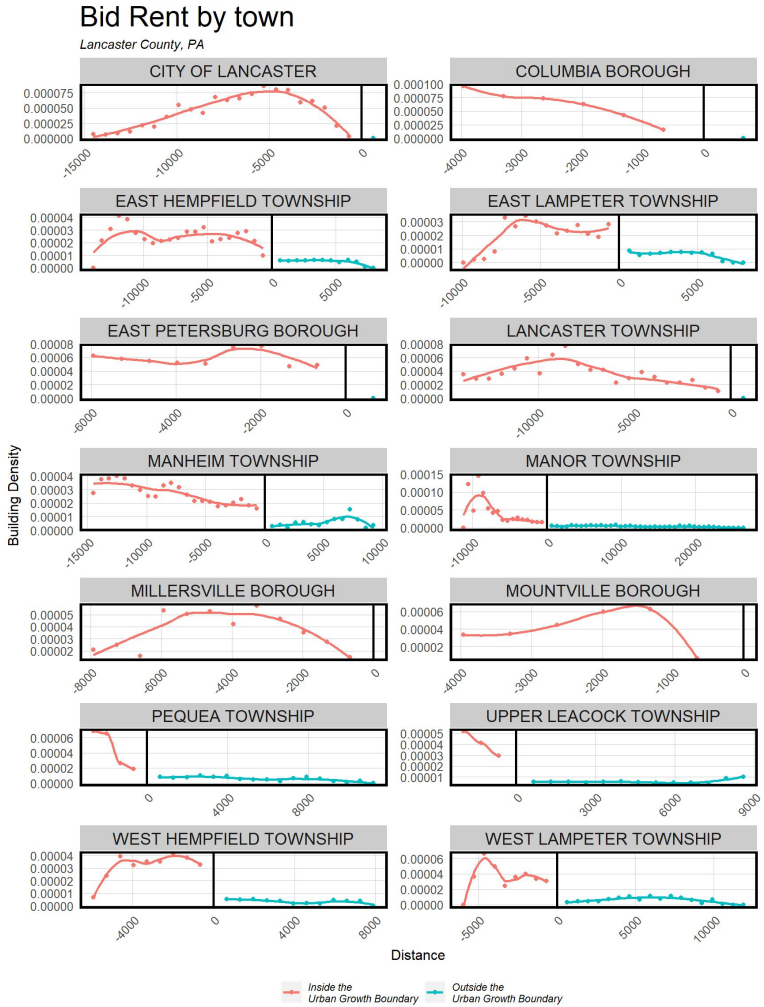
Bid-rent curves for select U.S. Cities



Bid Rent: Buliding Count as a function of distance to the Urban Growth Area

Lancaster County, PA





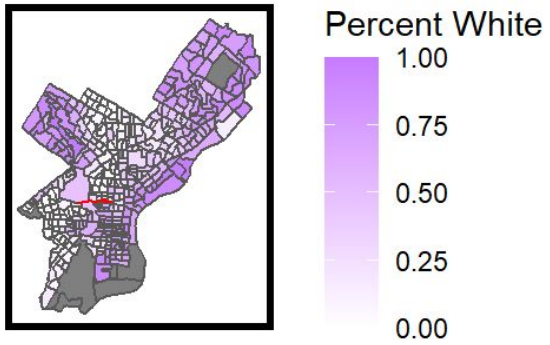
Which town would you extend the boundary?

Boundaries as a natural economics experiment - assumptions and design

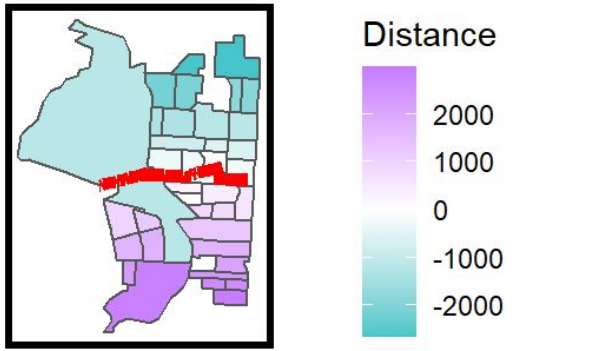
Boundaries in your community

Percent White

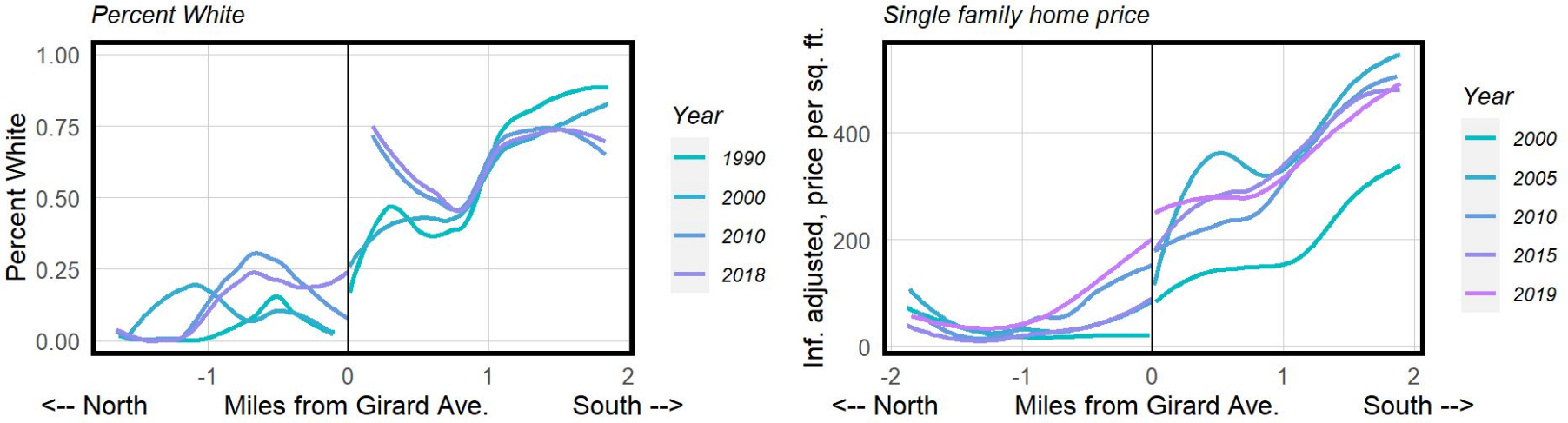
Girard Avenue in red



Distance to Girard



How Girard Avenue partitions two Philadelphia neighborhoods



Girard Avenue running from Broad St. west to the river. Includes Census tracts and real estate transactions within 2 miles of the Avenue. X-axis units in miles.

Lab objectives

1. Assignment 1 post-game show

2. Introduce lab geo-processing and visualization objectives

3. Chapter 2 code exercise (Lancaster County) in groups

Fin

Use case 2: Building a better Social Service Delivery System

Governments at all levels spend millions on delivering social, health and economic services to disadvantaged populations.

Governments lack the capacity to deliver these services themselves, so they contract with non-profits.

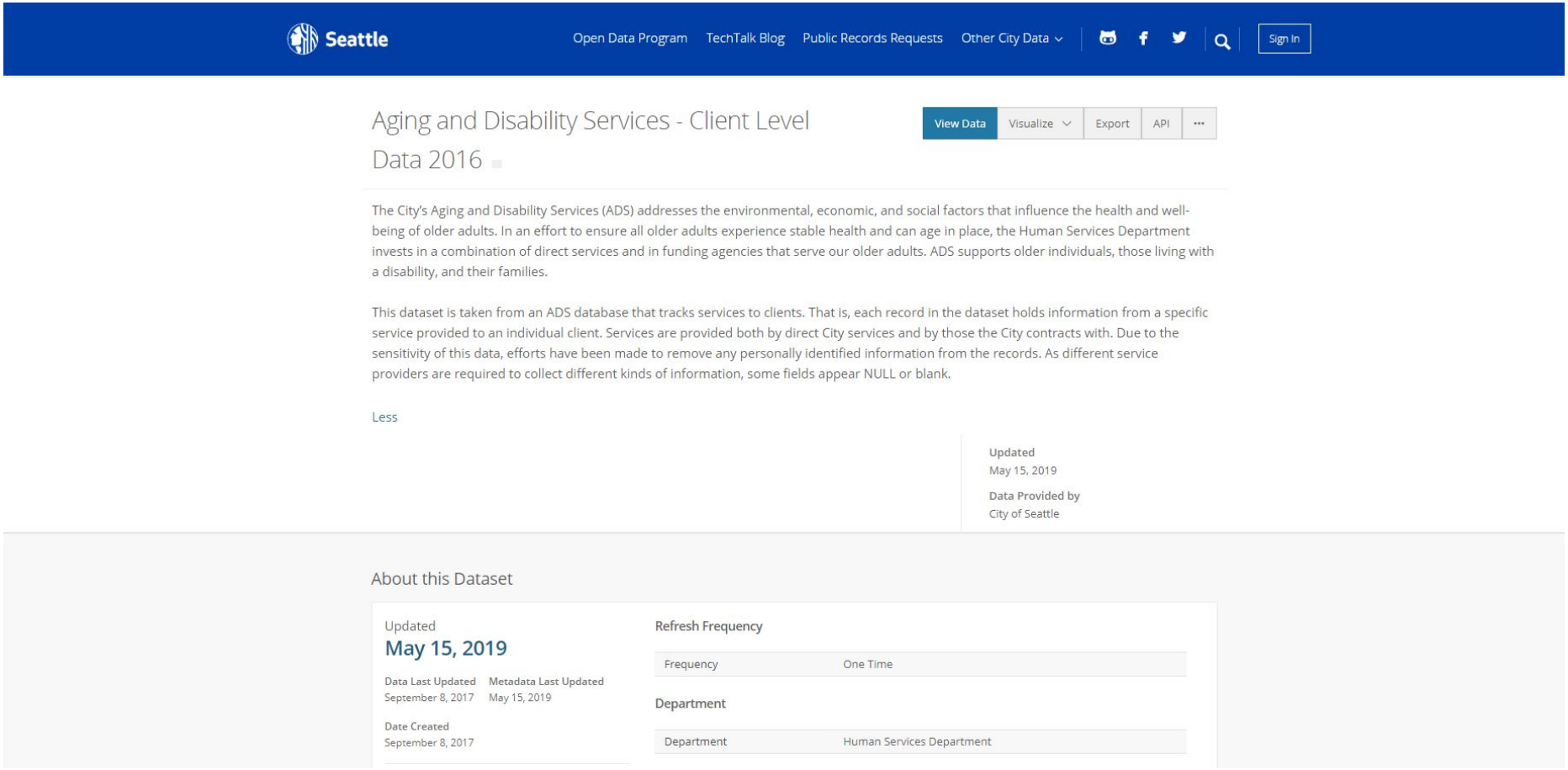
*This is a terrific example of how a budgetary decision-making, which places huge sums of money at the disposal of a single agency, must then be converted to operational decision making. Here, a single **agency** must figure out how to allocate millions to **non-profits** and eventually individual **clients**.*

What was the ‘business as usual’ approach to service delivery?

Can we take the client by service level data and use it to forecast local demand?

If so, we can do a better job ensuring the demand for services are properly aligned with the supply of community services.

Such alignment will optimize the cost/benefit ratio for the agency.



https://data.seattle.gov/Community/Aging-and-Disability-Services-Client-Level-Data-20/vhuq-wqf8/data

Indicators

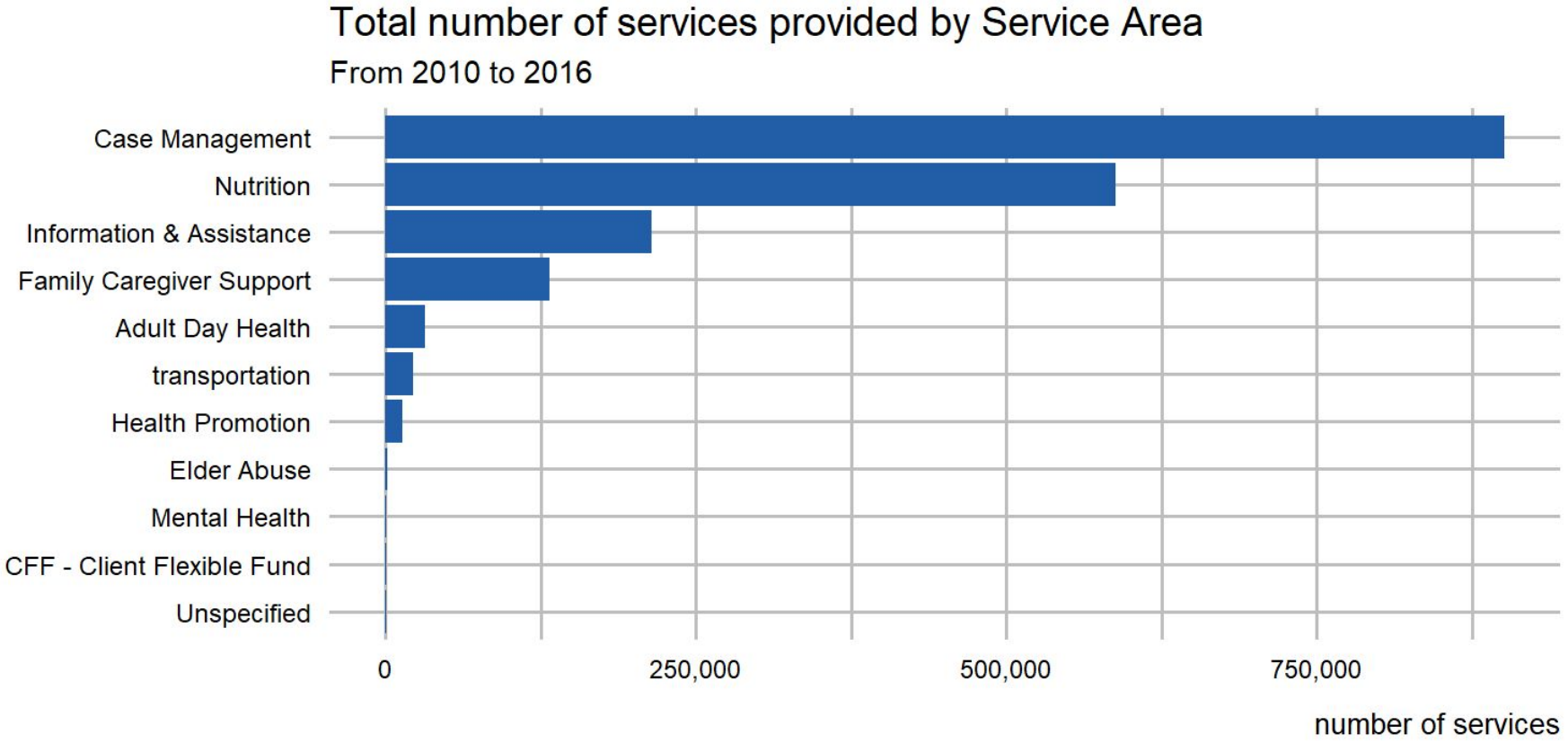


Figure 8

Indicators

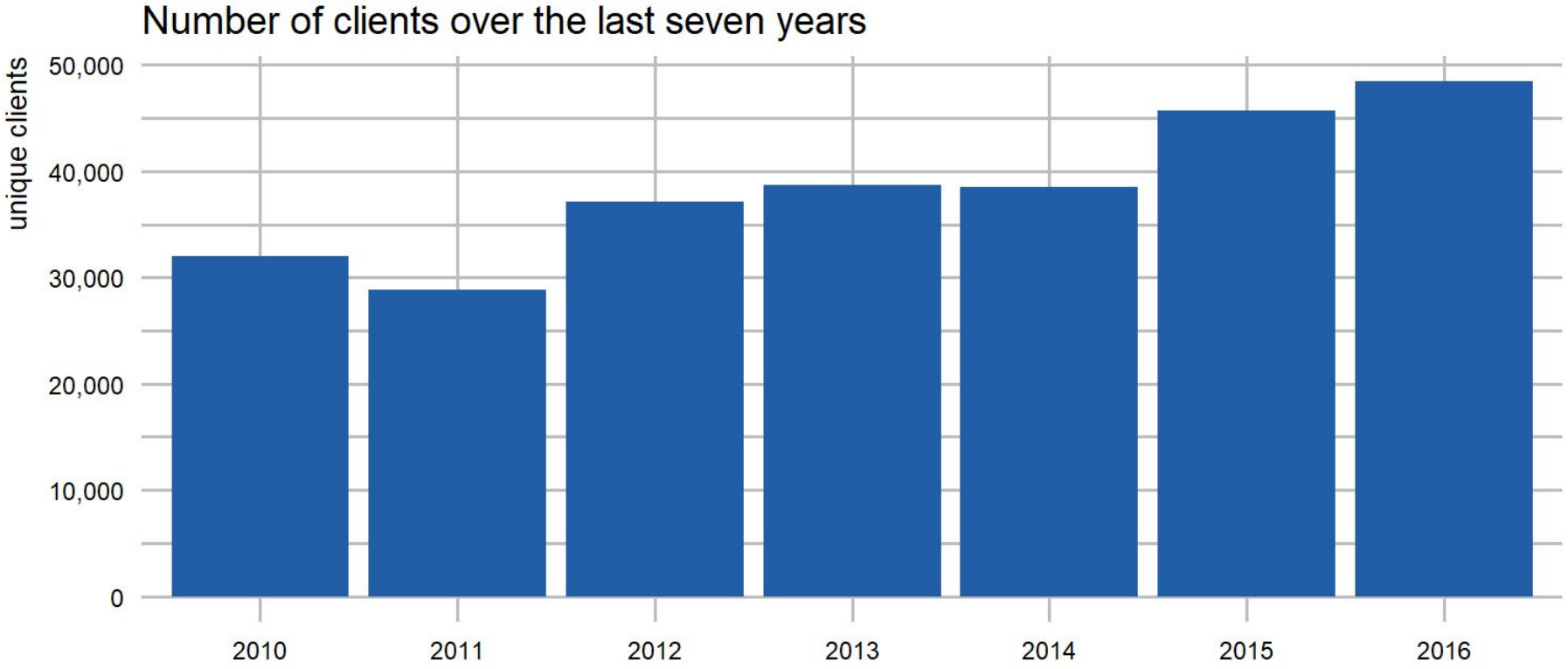


Figure 1

Indicators

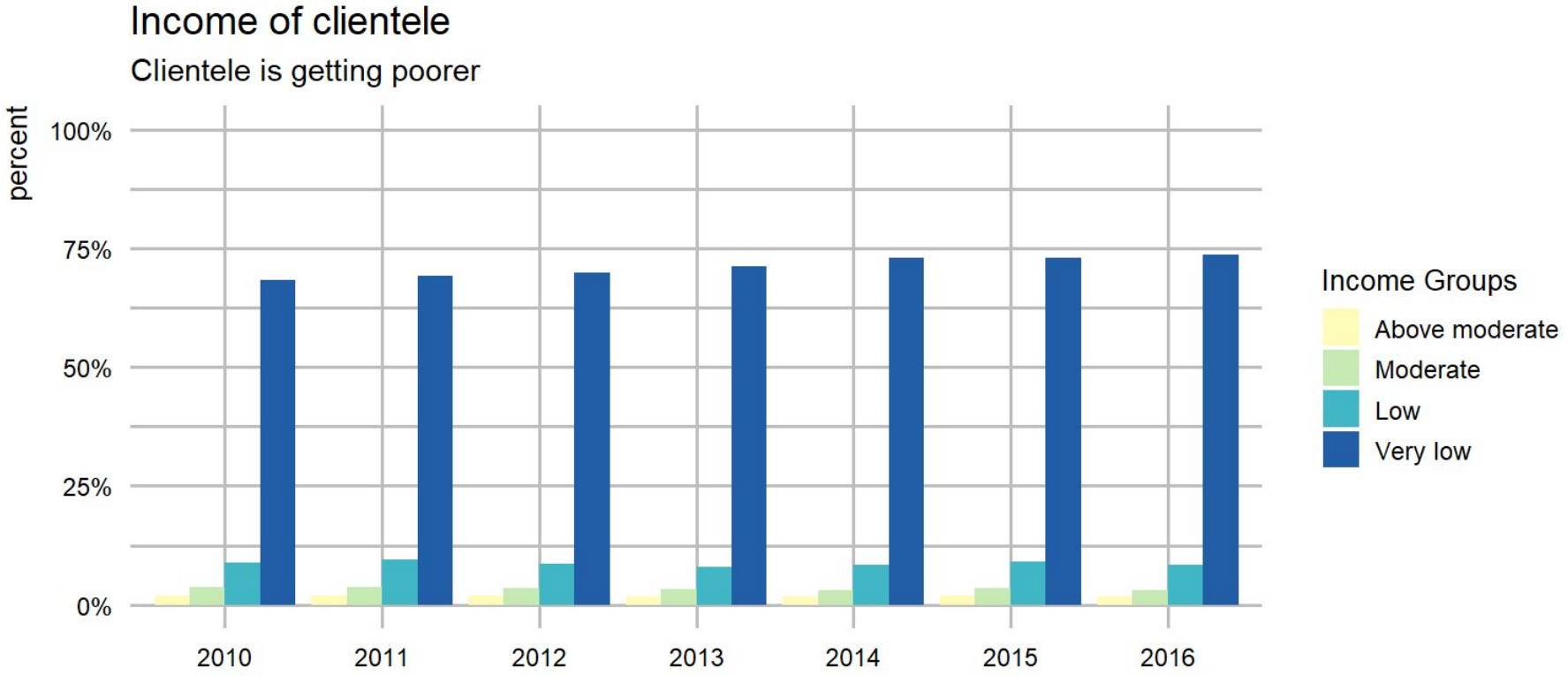


Figure 5

Indicators

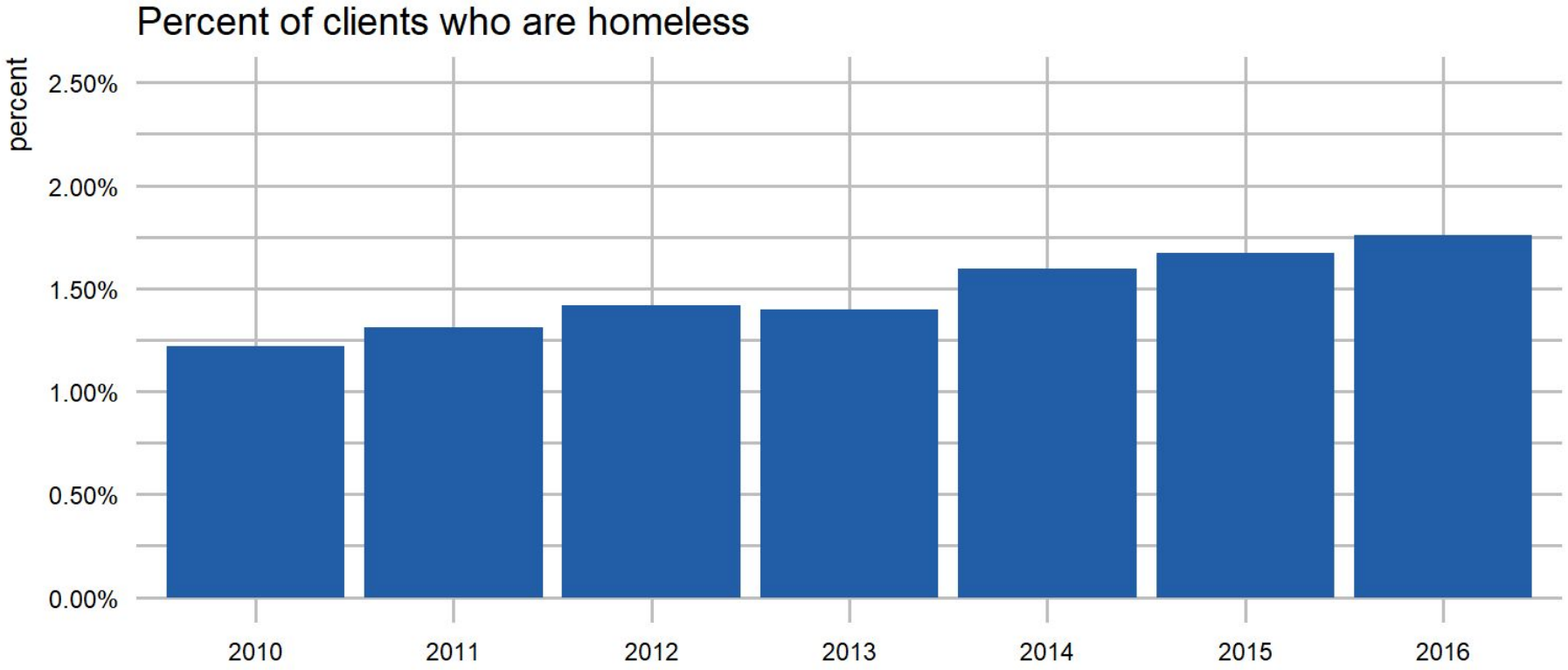
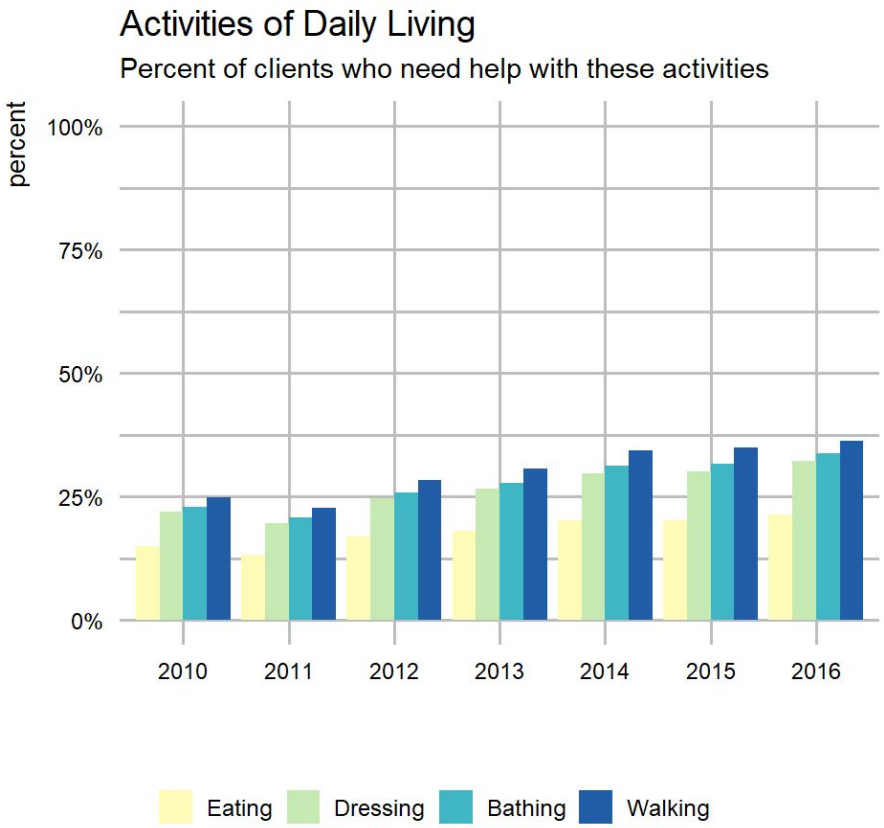


Figure 6

Indicators



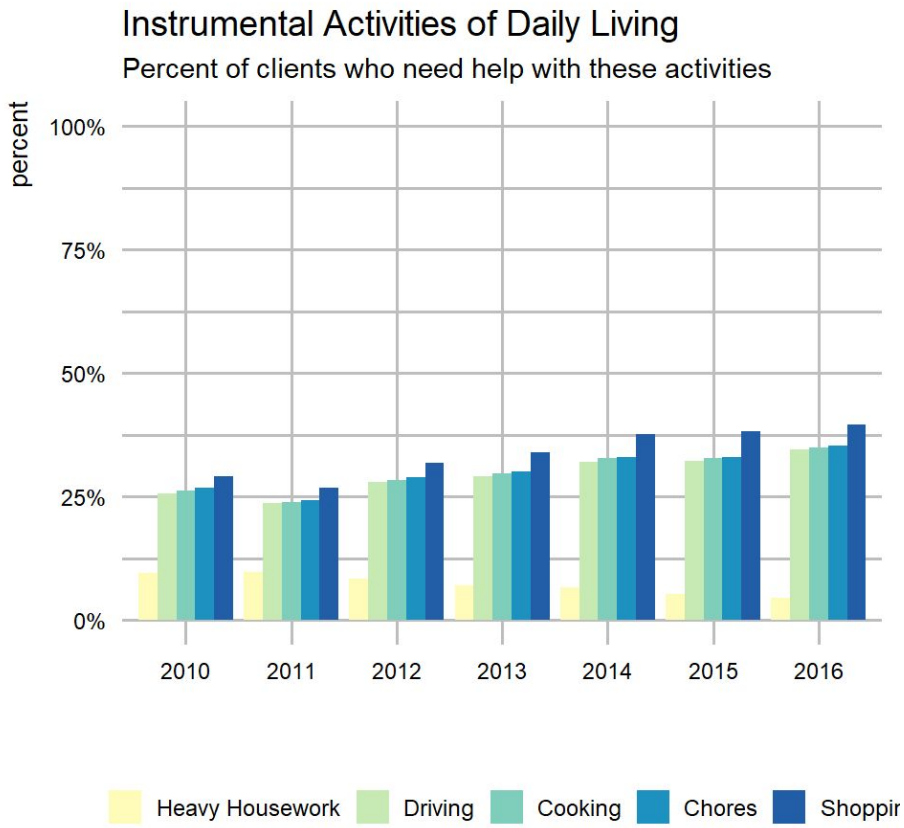


Figure 10

Indicators

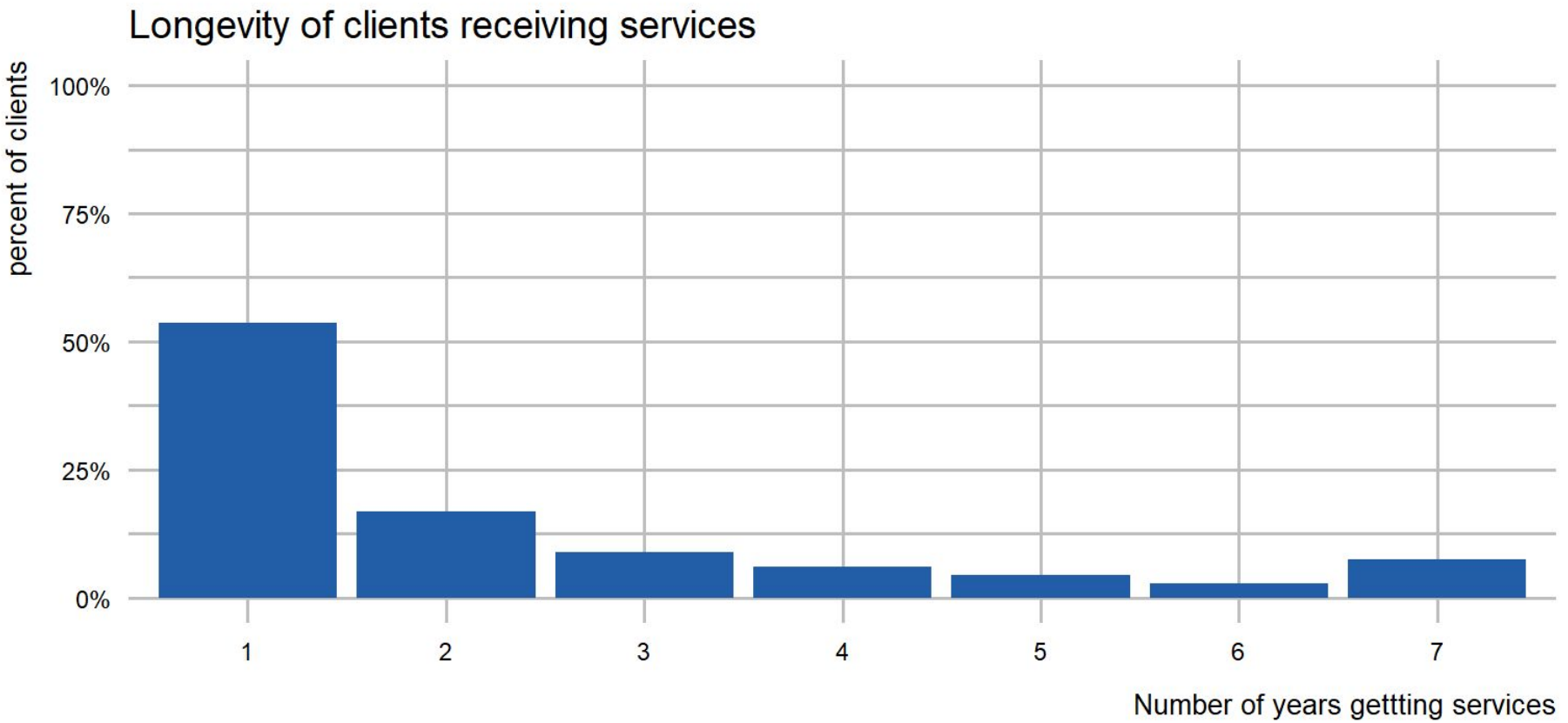


Figure 11

Indicators

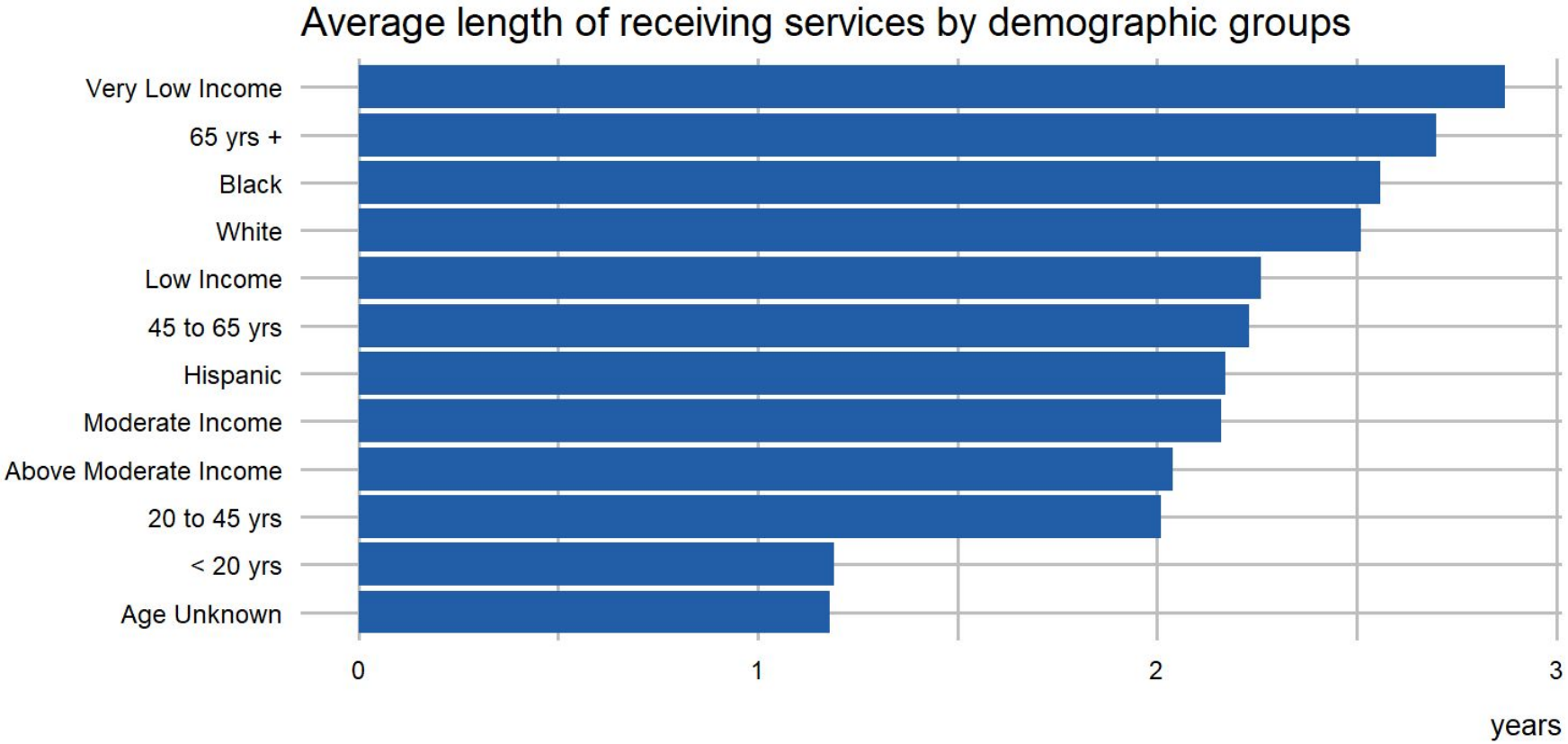


Figure 13

Forecast - Healthcare analytics

The models were trained on a sample of 2010 - 2015 data and then tested on clients who received services in 2016

The data are split into five different ‘stories’:
- Demographics
- Location
- Activities clients need help with
- Patient history
- Service Providers for that service

Three separate models are estimated for each story - a Negative Binomial model, a Random Forest model, and an XGBoost model. We then ‘ensemble’ the predictions from these sub-models into a final model.

Forecast

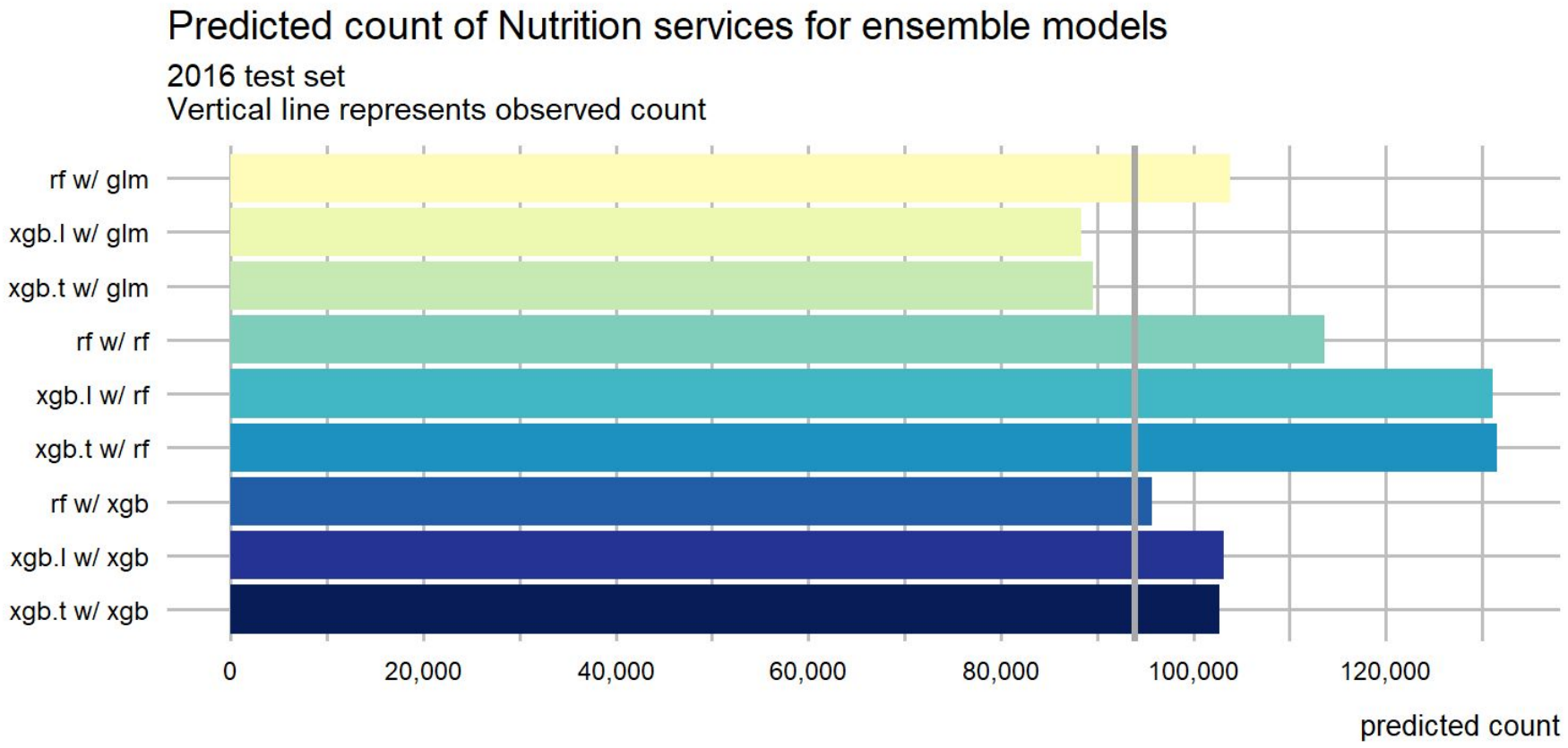


Figure 14

Forecast

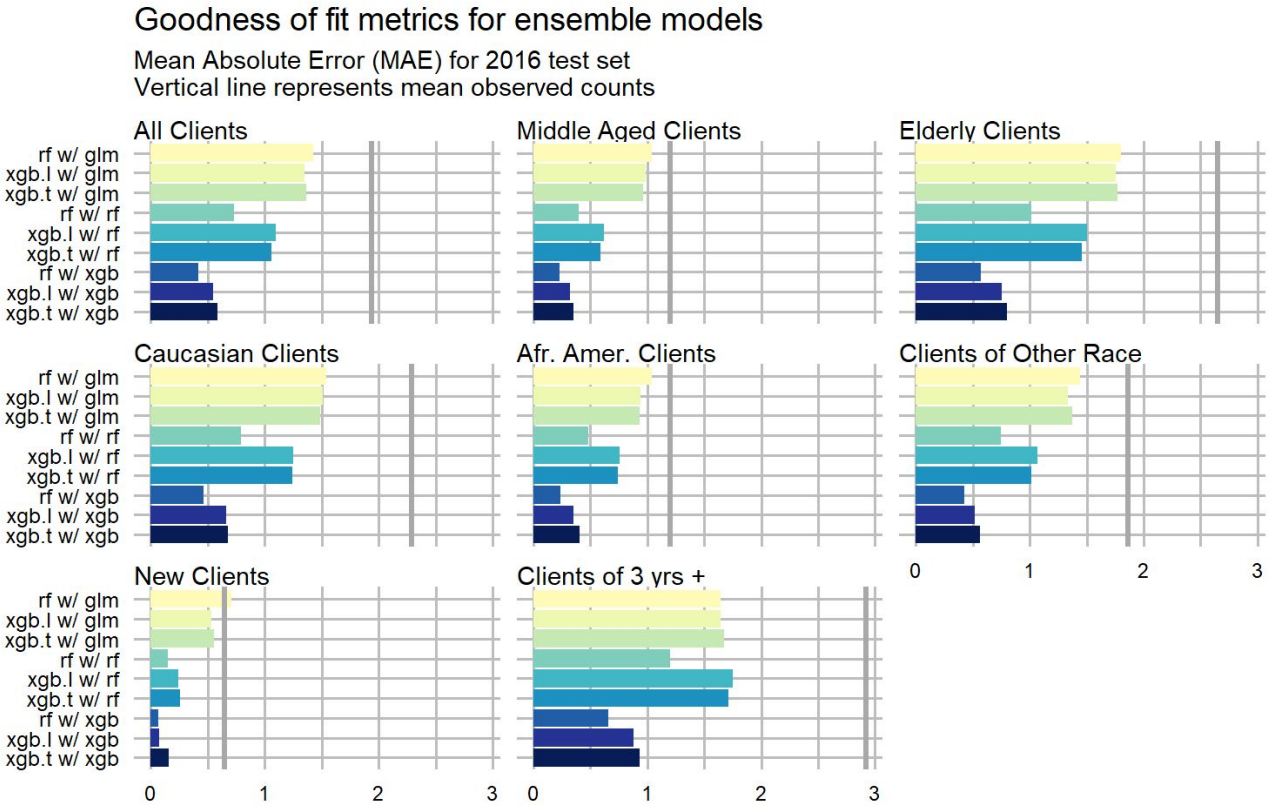
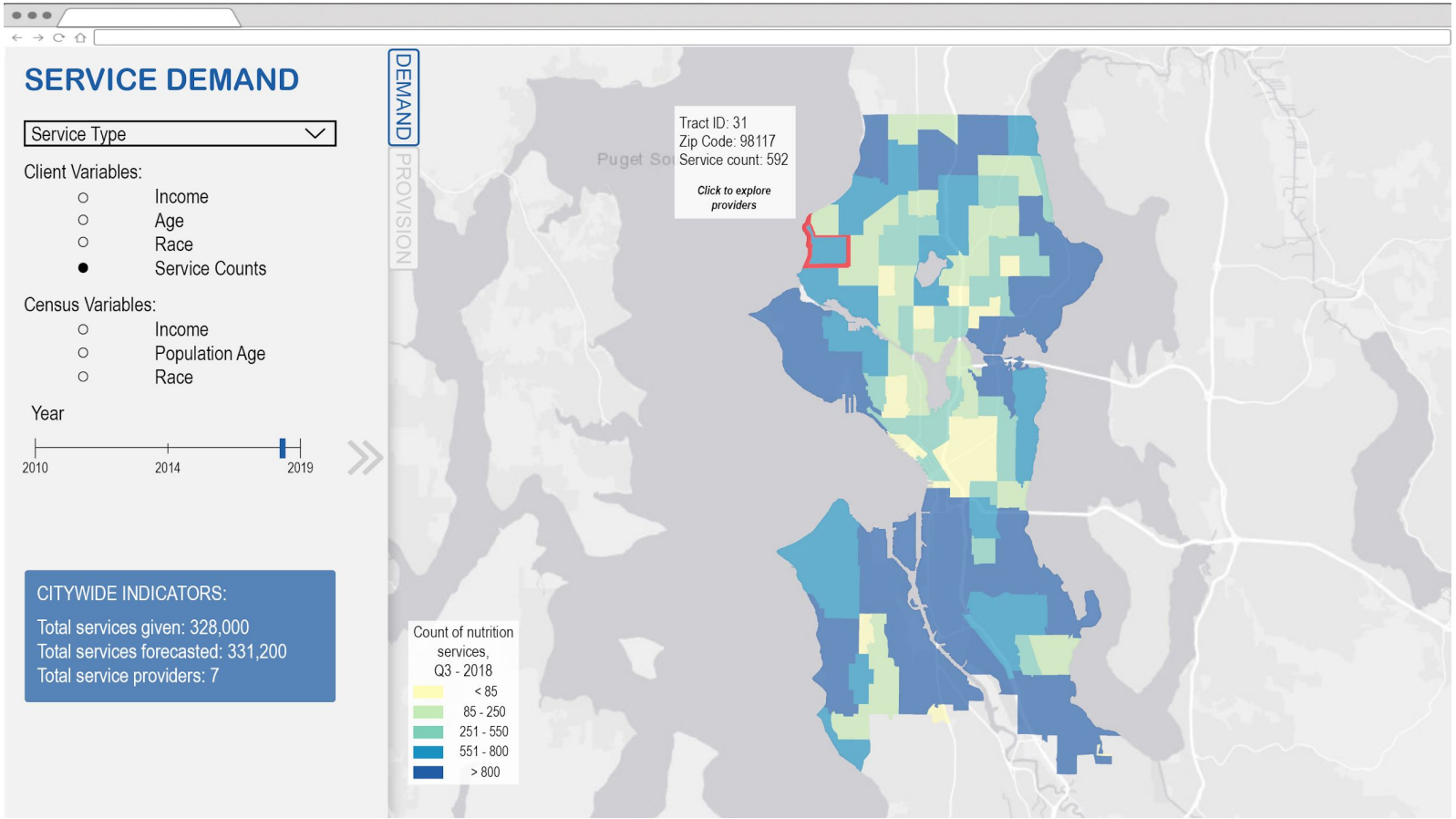
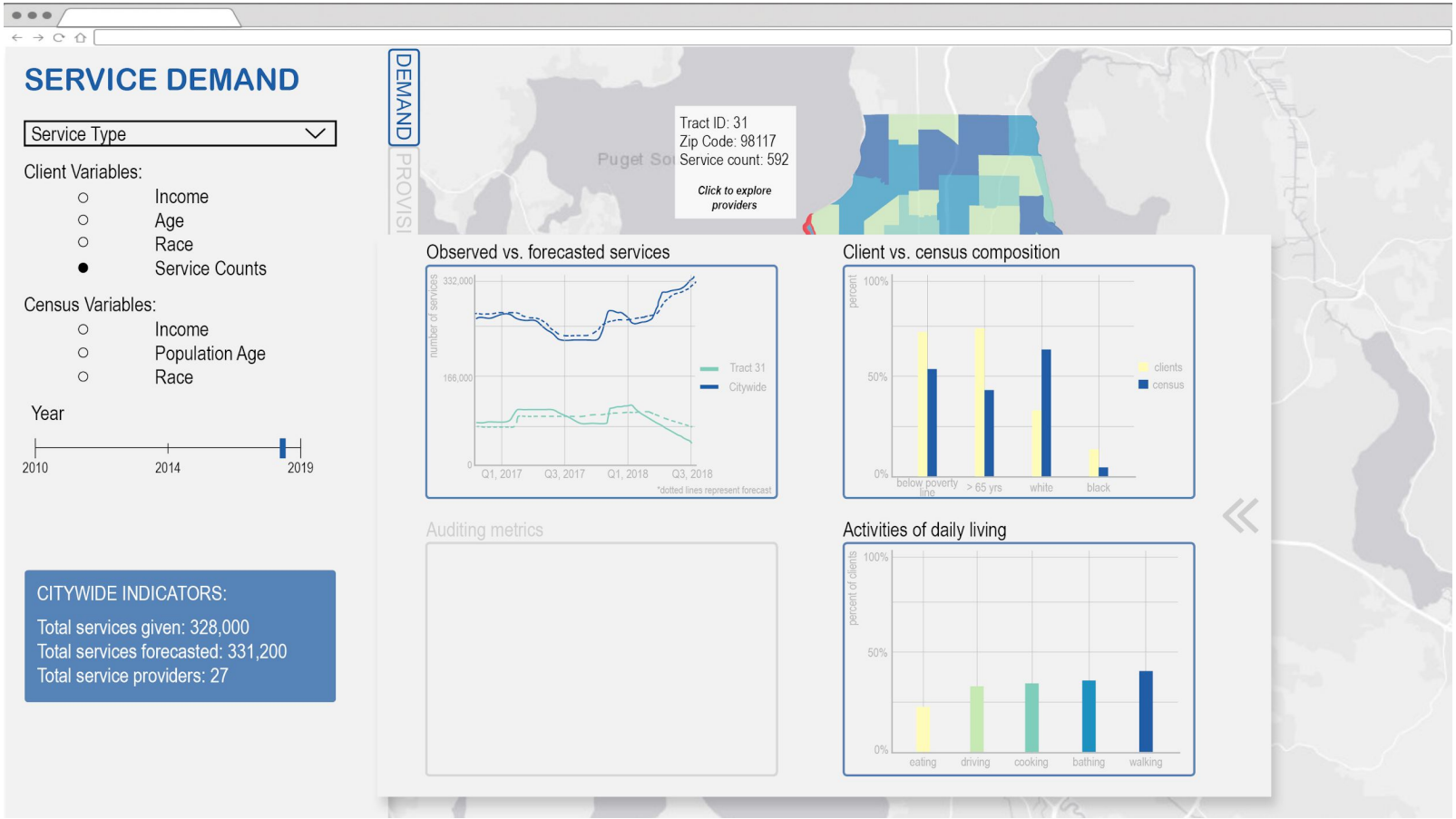


Figure 15

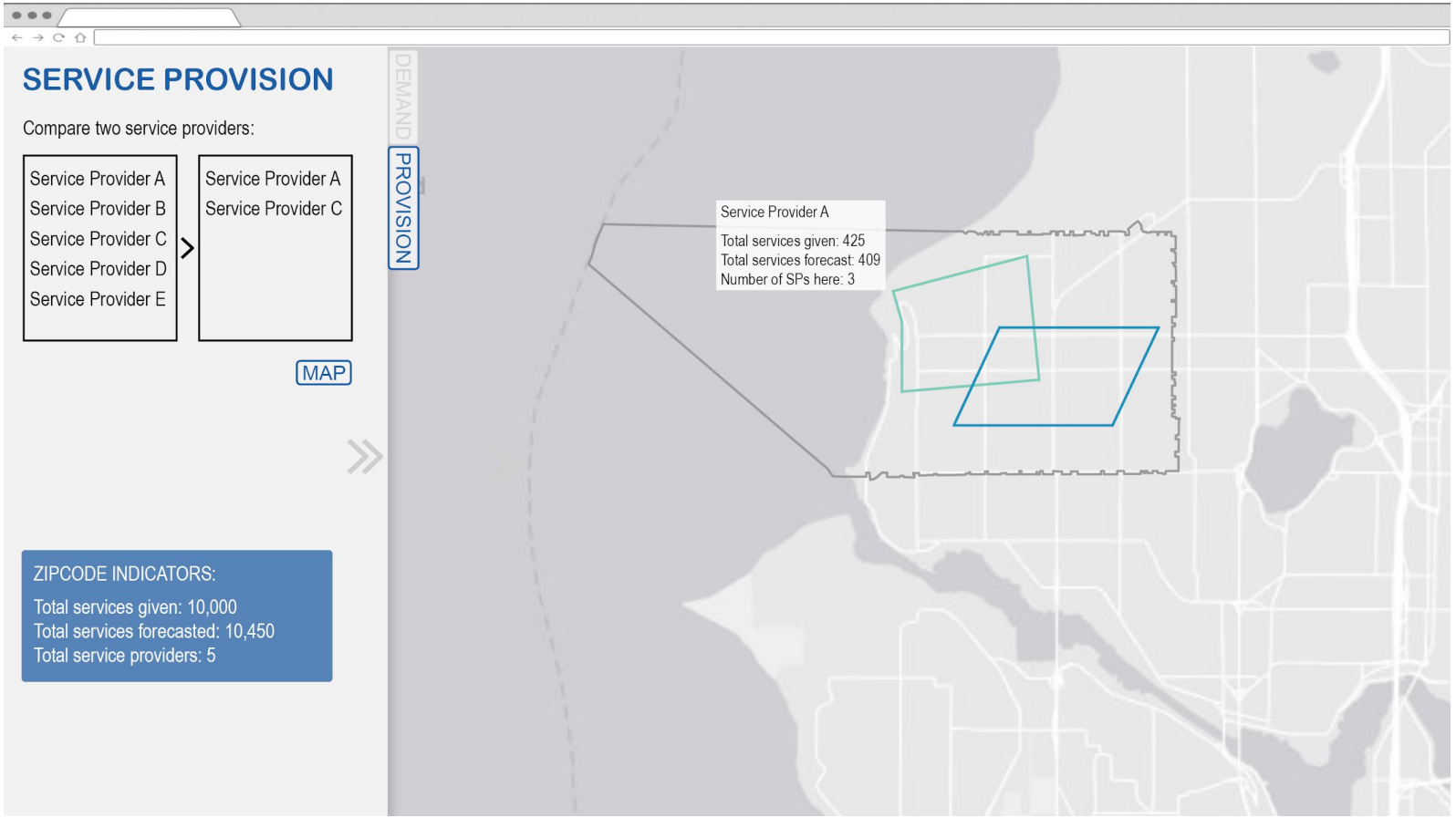
Dashboarding and demand/supply alignment



Dashboarding and demand/supply alignment



Dashboarding and demand/supply alignment



Dashboarding and demand/supply alignment

Comprehensive Planning & Forecasting

Housing

What trends today could we never have forecasted in 2001?

Comprehensive Planning & Forecasting

What **Housing** trends do you think are going to be important in 2041?