Modeling VMT Demand from Supply

Household Vehicle Miles Traveled is explained by local and regional accessibility

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Purpose: VMT response to network

Legislative Background

Greenhouse gas emissions targets:

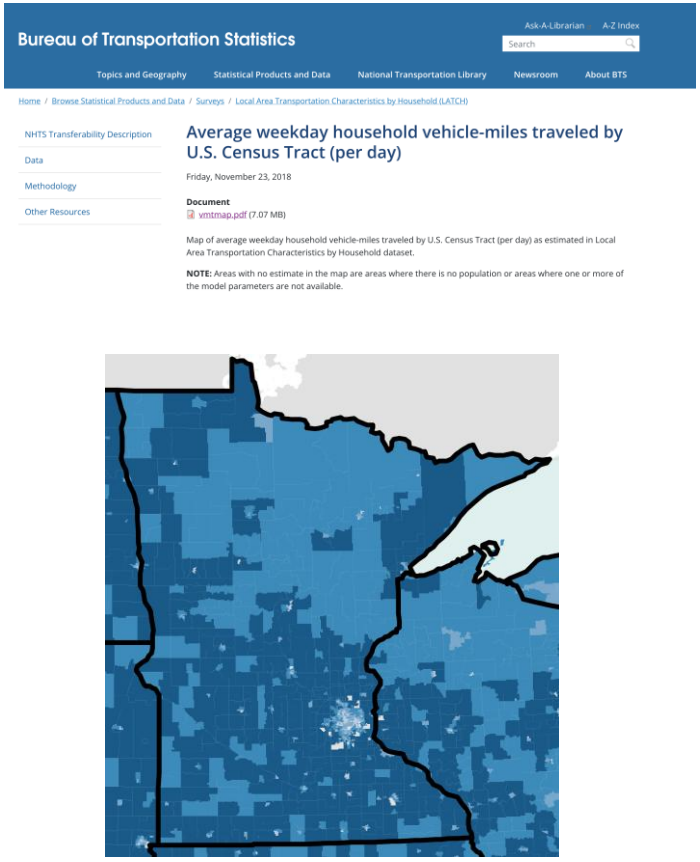
- Chapter 216 (2023): Set greenhouse gas emissions goal for Minnesota across all sectors
- Chapter 174 (2023): requires the commissioner of transportation to establish greenhouse gas emission reduction targets for the transportation sector

Transportation project assessment and mitigation:

- Chapter 161 (2023): Requires MnDOT to assess and mitigate greenhouse gas emissions for highway expansion projects
- Chapter 127 (2024): Amends 161.178 to add a requirement of "assessing a portfolio or program of projects instead of on a project-by-project basis" by 2027

Study approach

- **statistical**
  - spatial regression framework
  - elasticity model
  - probabilistic, estimated with uncertainty
- **where, and from whom**
  - people create VMT
  - people share households
  - household characteristics influence VMT
  - household location influences VMT



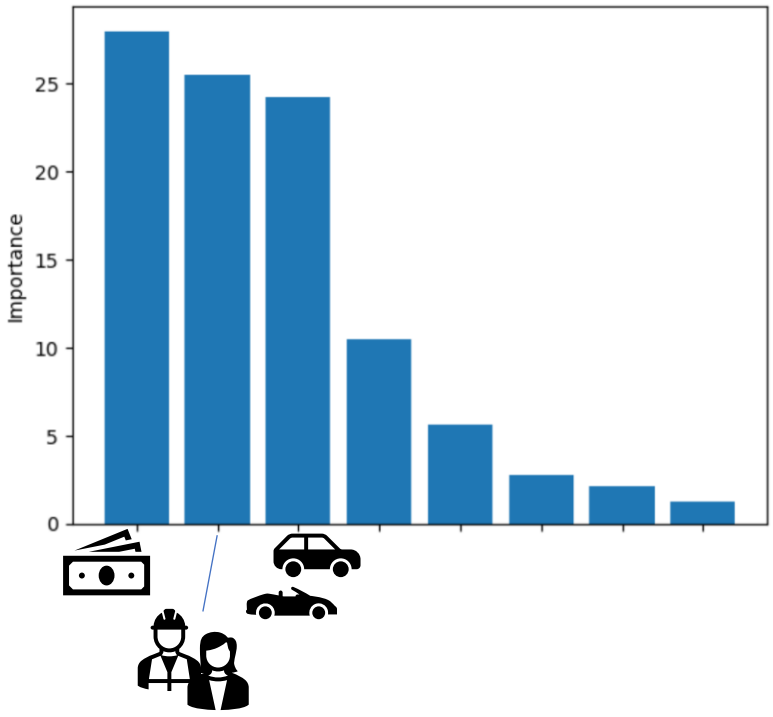
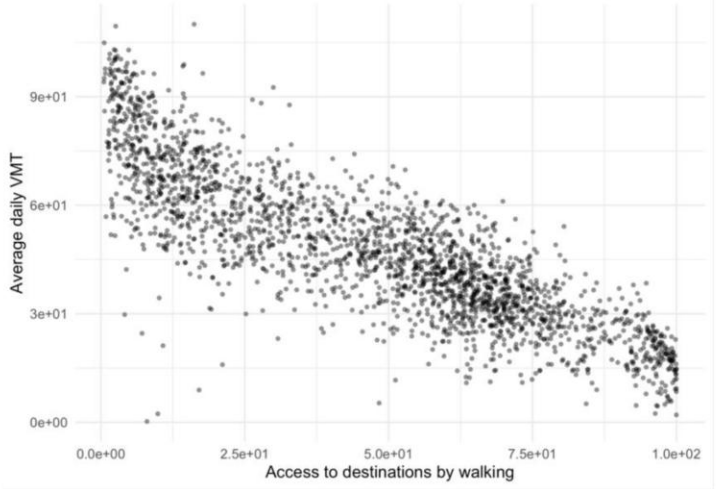


FIGURE 2 Feature importance of selected explanatory variables

Local and regional accessibility and VMT

VMT strongly influenced by **local** accessibility



McCahill et al. 2022

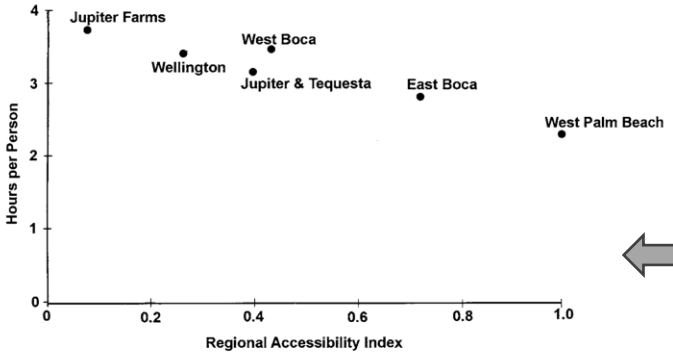


FIGURE 3 Household VHT versus regional accessibility. VHT per capita declined as a linear function of regional accessibility, dwarfing the effects of local density and land use mix (*12*).

Ewing & Cervero 2001

VMT strongly influenced by **regional** auto accessibility

Overview

Data Integration

Travel Survey

TRAVEL BEHAVIOR INVENTORY

Spatial Accessibility

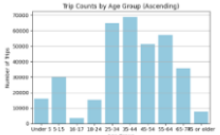
ACCESSIBILITY OBSERVATORY

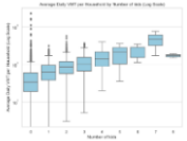
Census Geographies

IPUMS NHGIS

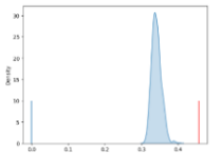
Exploratory Analysis

Non-Spatial Correlation



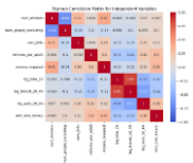


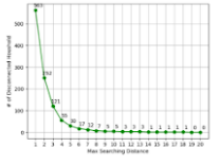
Spatial Pattern Analysis



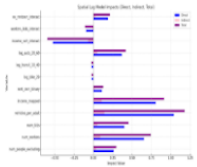
Spatial Statistics

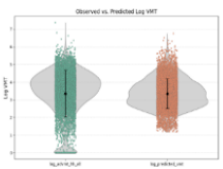
Model Setup



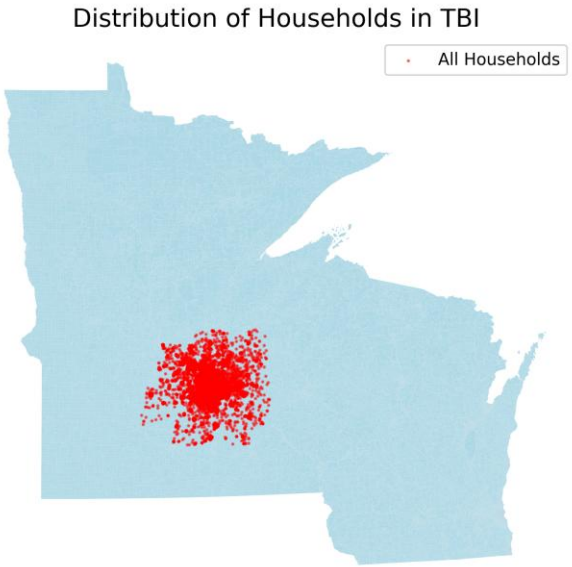


Result Interpretation

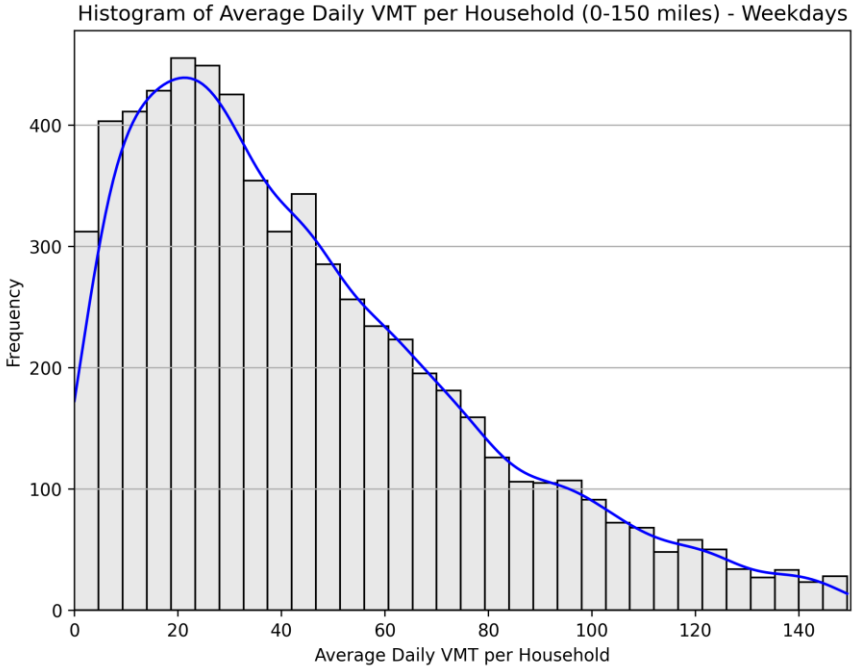




Household survey sample 2019 (pre-COVID)



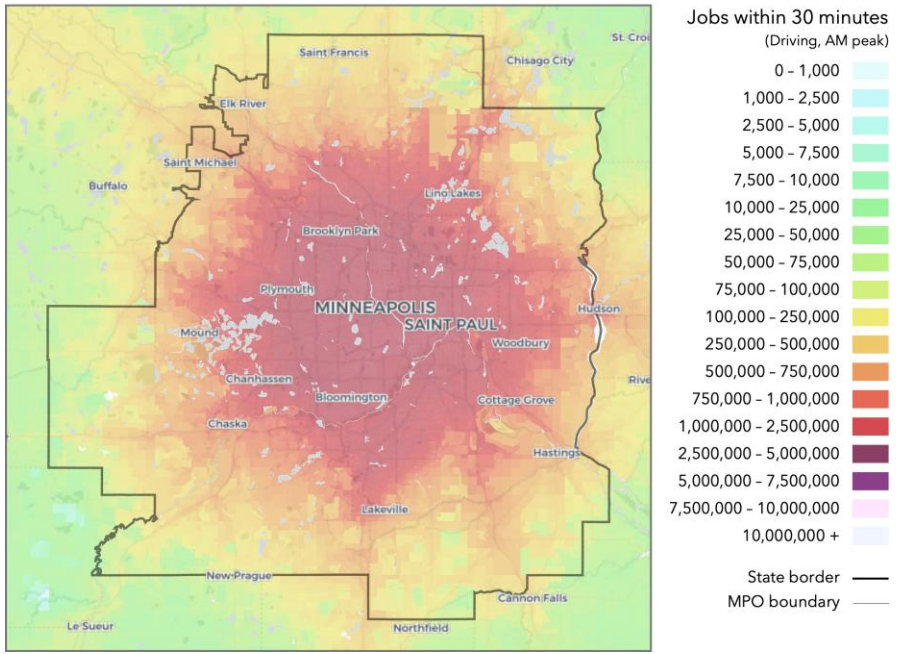
16,152 participants from 7,837 households



Accessibility data

- Access to jobs
  - NAE* data
    - bike
    - auto
    - transit
  - summed over travel thresholds

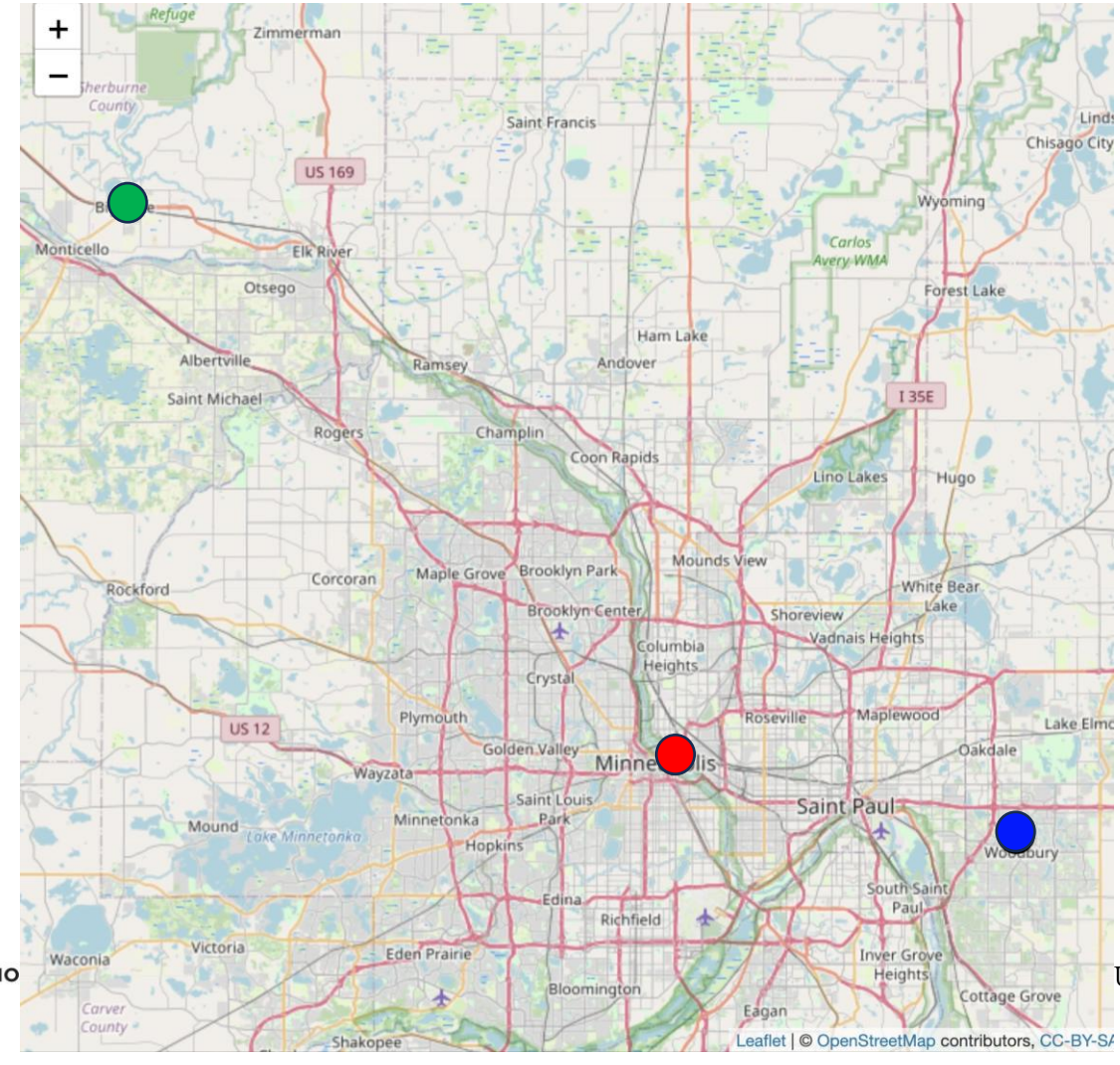
Metropolitan Council *2023 total job accessibility, 30 min by auto*



*National Accessibility Evaluation: access.umn.edu

Big Lake

Minneapolis

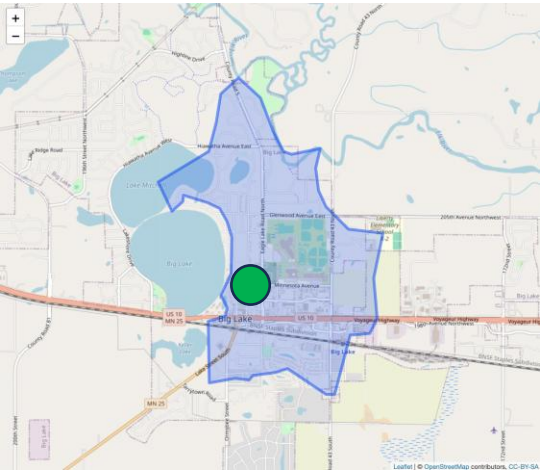


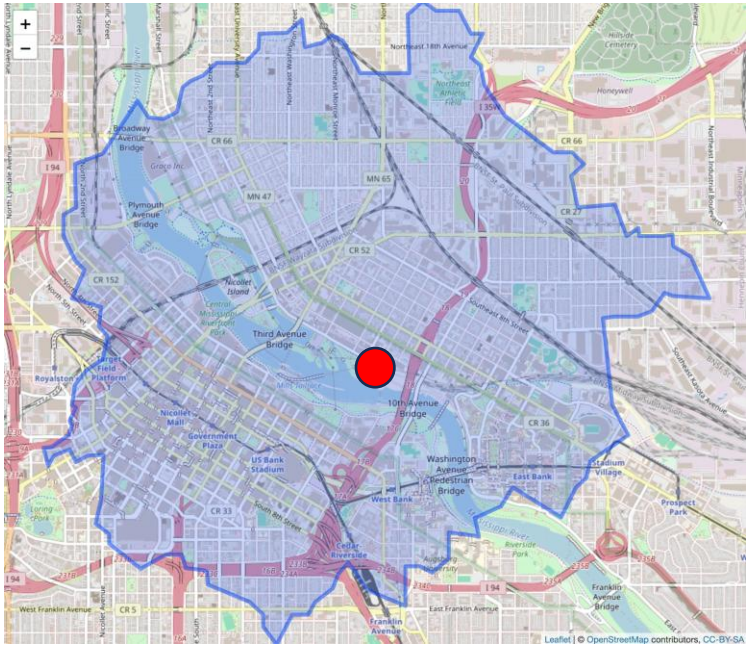
Woodbury

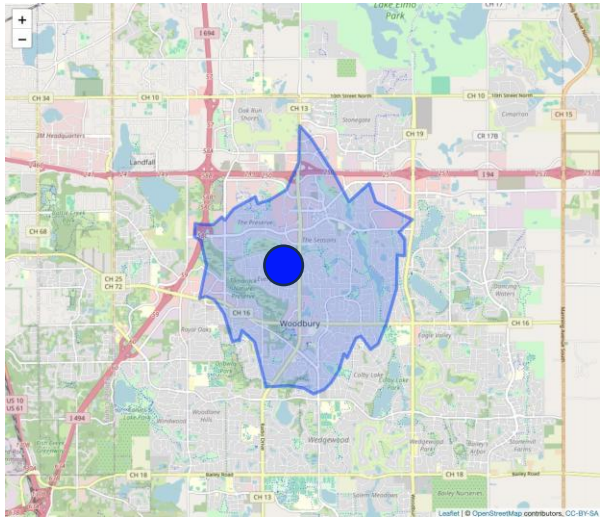
CENTER FOR TRANSPORTATION

UNIVERSITY OF MINNESOTA

Local accessibility



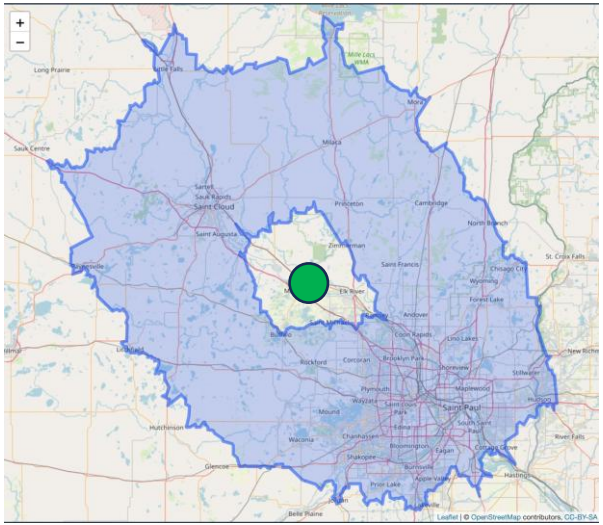


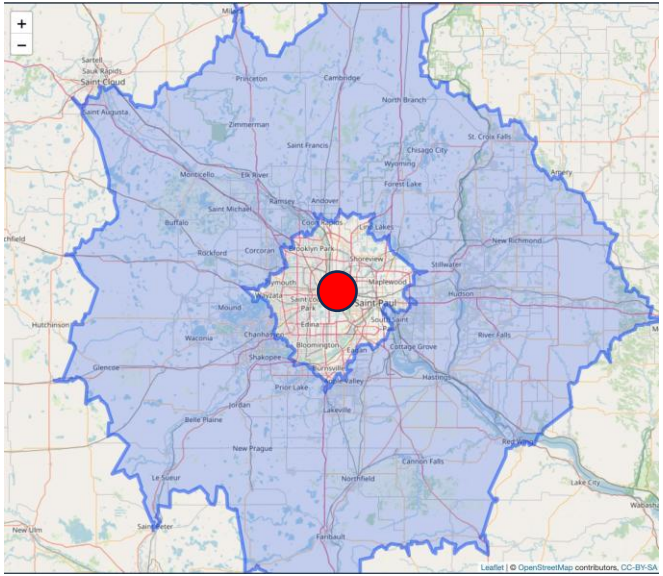


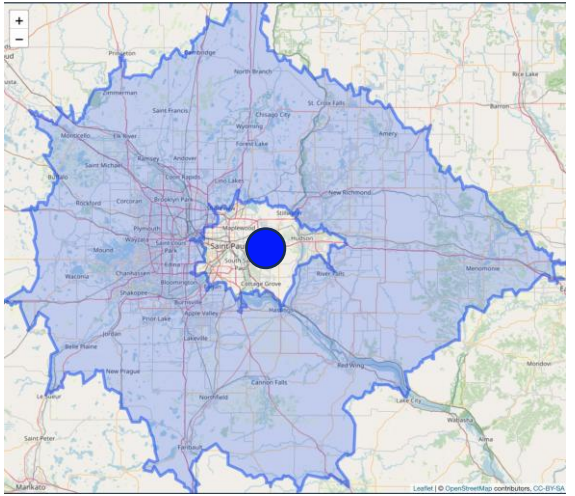
20 minute travelsheds
(safe & comfortable network)

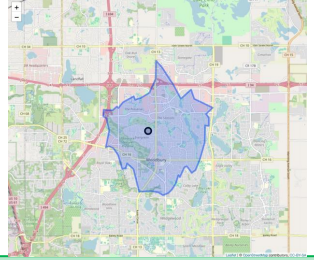
20 – 60 min driveshed (8am)

Regional accessibility





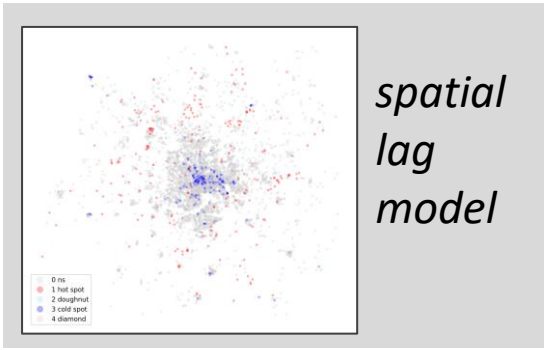




<20 min

10-40 min

Local accessibility



spatial lag model

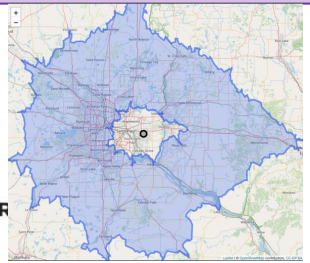
(-)

VMT

(+)

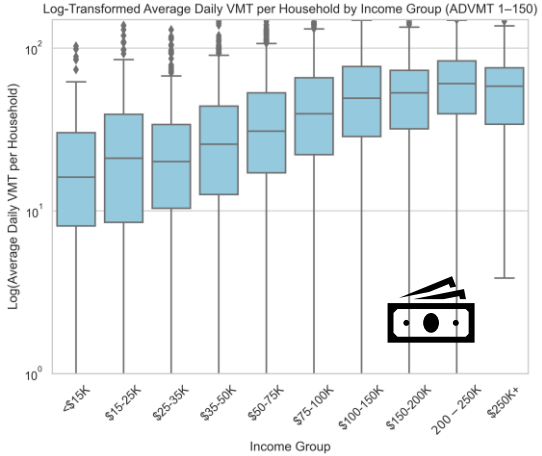
income
 # workers
 # children
 # cars

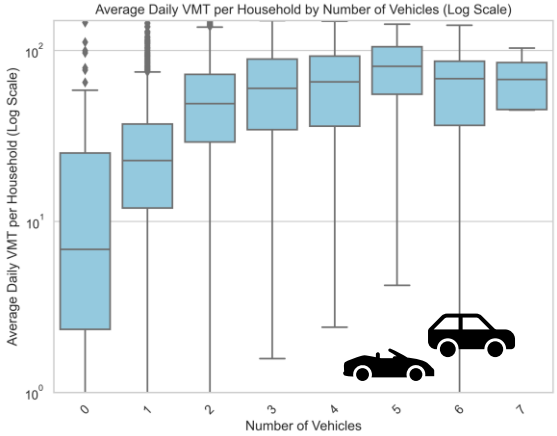
Regional accessibility

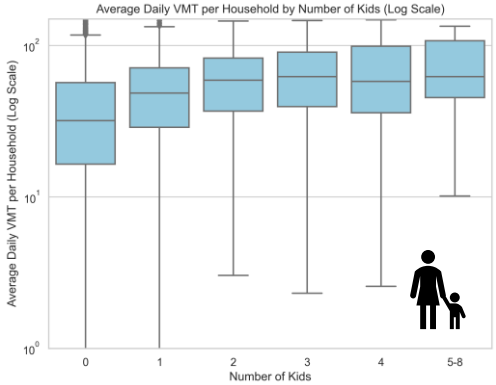


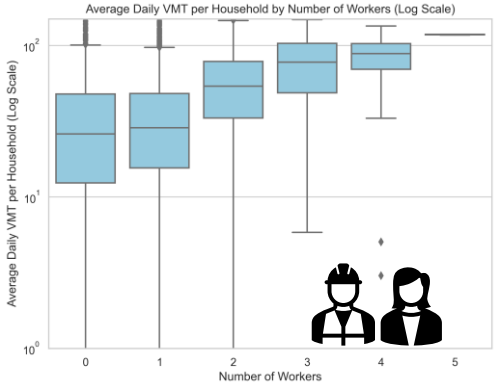
20-60 min

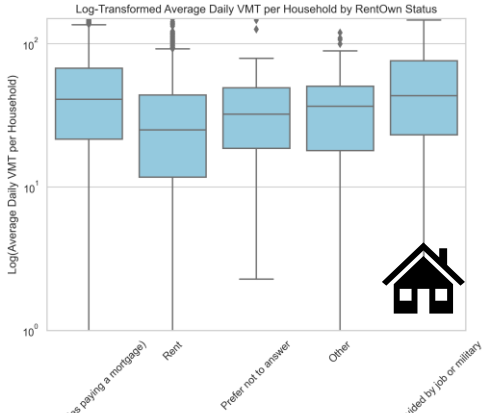
Demographic predictors



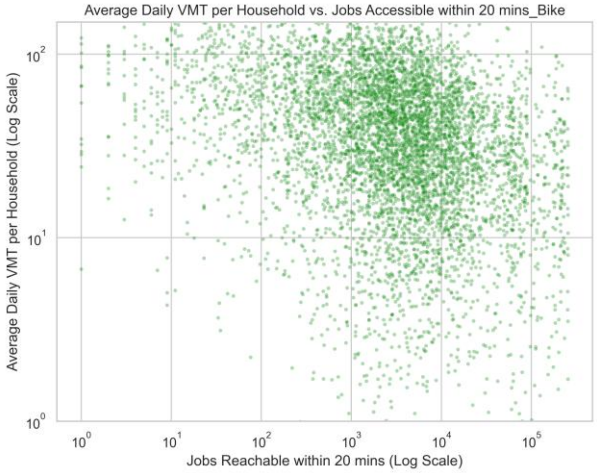


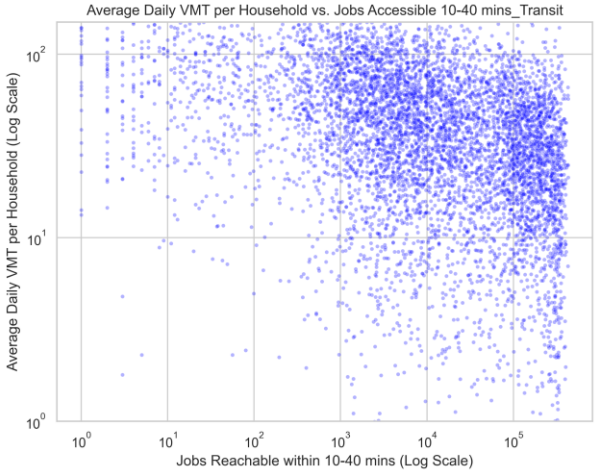


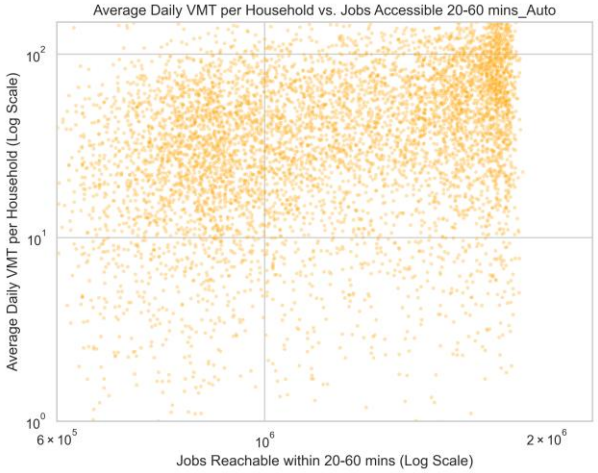




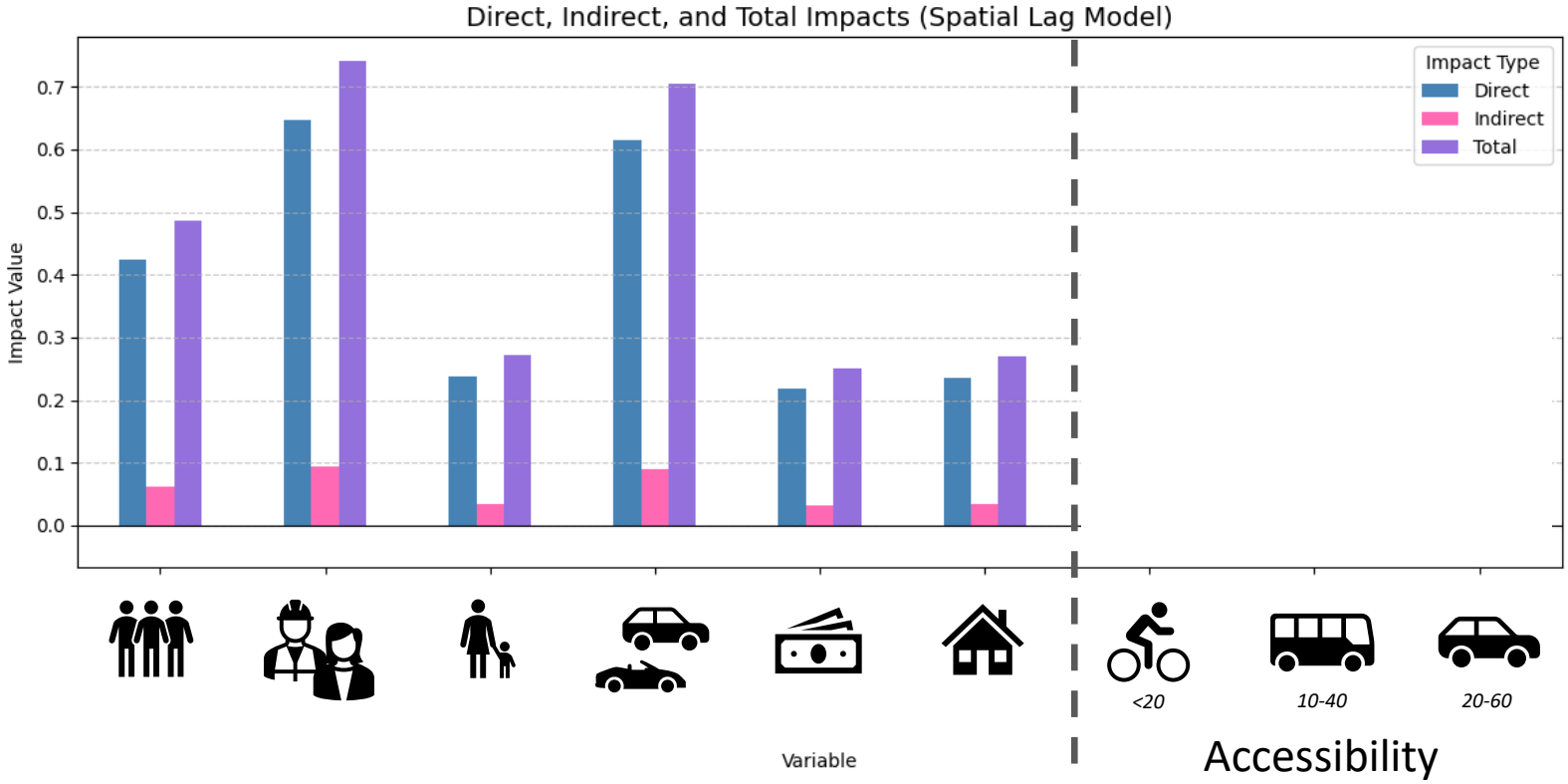
Accessibility predictors



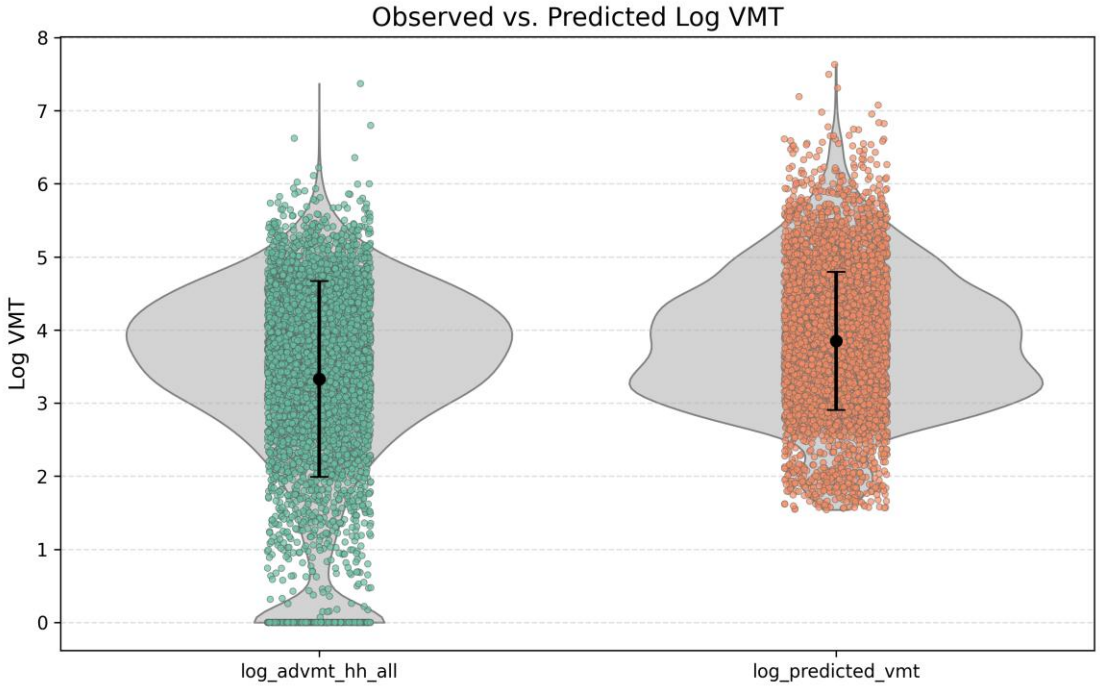




Statistical results



Household VMT is highly variable



model does a good job with central tendency

model not so good at predicting very low VMT households

Implied elasticites

- % change in *X* ->
  % change in VMT

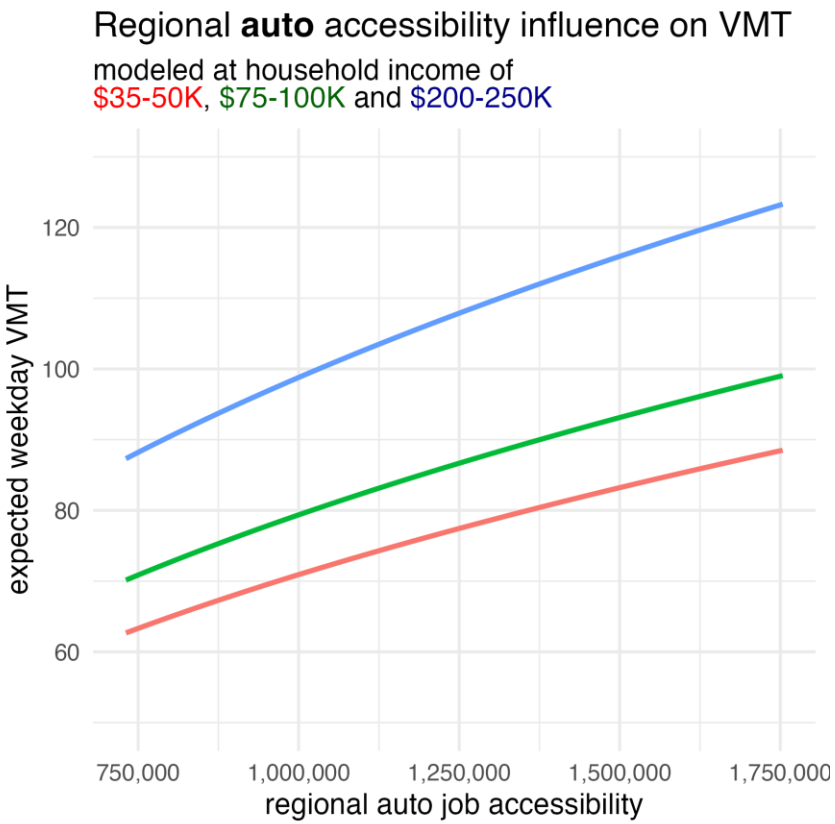
- bike: -0.026
- transit: -0.030
- auto: 0.42

for given household on avg:

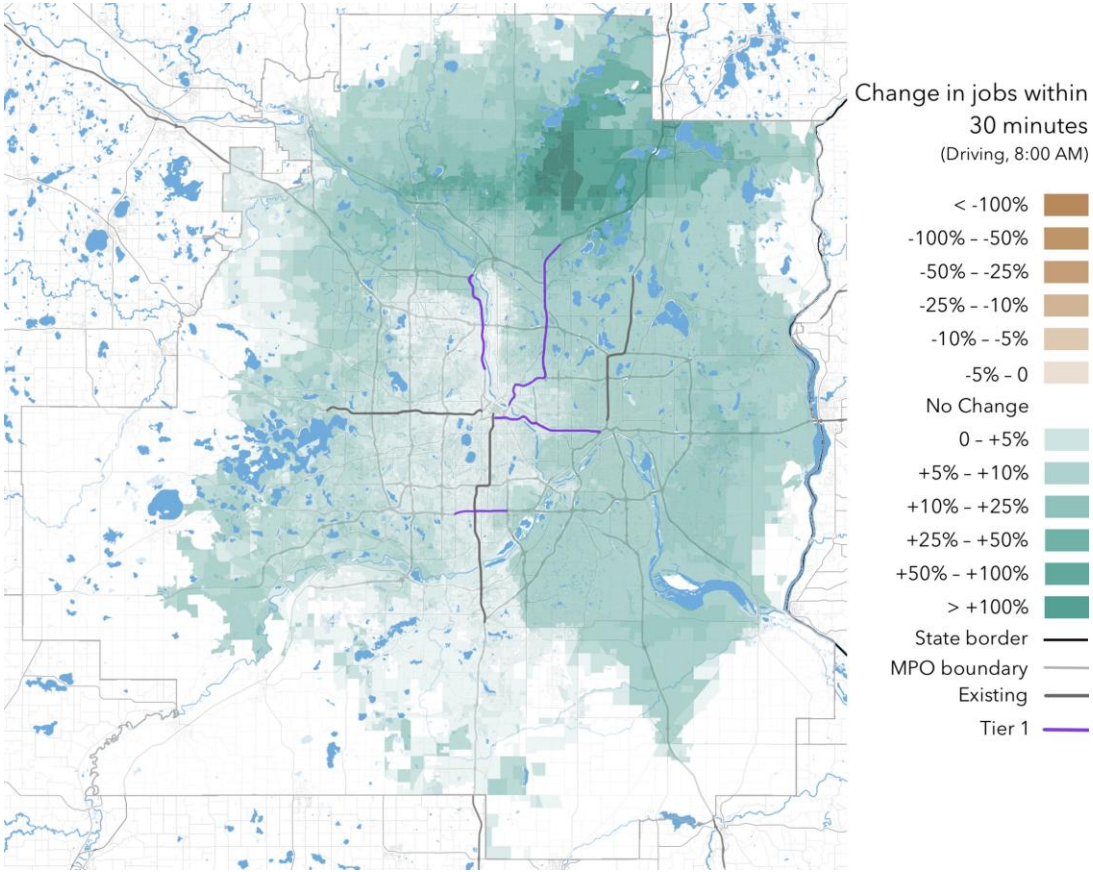
- *doubling* of transit or bike access -> 3% decrease in expected VMT

- 10% increase in regional auto access -> 4% increase in expected VMT

expected VMT: access x income



what is a 10% increase in regional auto access?



Carlson et al. 2019:
Accessibility Impact Analysis of I-94 MnPASS Lanes by Auto and Transit

Questions?

- Next:
  - applicability of model to other regions with similar household survey data
  - tools to explore expected VMT for households under network change
  - moving from cross-sectional to longitudinal analysis