

# Assessing the Transit Productivity of Park-and-Ride Using ArcGIS Tools

J. M. (Mike) Pogodzinski  
Department of Economics  
San Jose State University  
[j.m.pogodzinski@gmail.com](mailto:j.m.pogodzinski@gmail.com)

# Agenda

- The economics of park-and-ride
- Types of analysis
  - Stop-level analysis
  - Route-level analysis
- How is GIS Used?
  - Tools of GIS
  - Data
- Example: Santa Clara Valley Transportation Authority (VTA)
- Results

# The Economics of Park-and-Ride

- Benefit-Cost Analysis of Transit
  - Social Cost of Congestion
  - Social Cost of Pollution
- First-best and Second-best Solutions
- Financing Transit and the Role of Park-and-Ride
- Measuring Transit Productivity
  - Boardings per Revenue Hour
  - Boardings per Stop
  - Boardings per Stop per Trip

# Types of Analysis

- Route-level analysis
  - Pros: direct focus on performance variables of greatest interest
  - Cons: fewer observations at a necessarily higher level of aggregation
- Stop-level analysis
  - Pros: many observations, low level of aggregation, plausible to associate neighborhood demographic/economic variables
  - Cons: cannot recover direct performance measures of greatest interest

# How is GIS used?

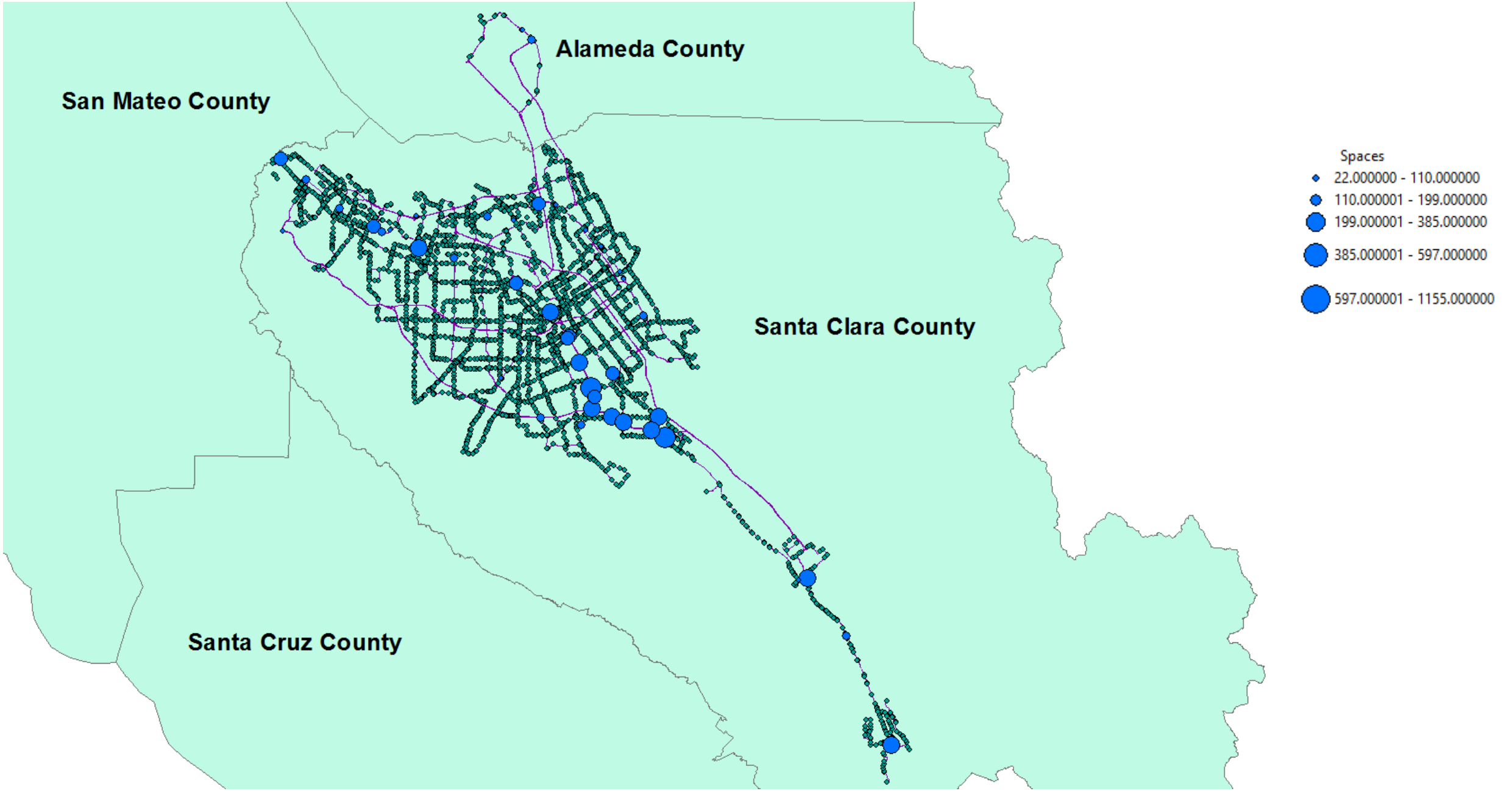
- Tools of GIS
  - Proximity of routes/stops to park-and-ride lots
  - Network impedences
- Data
  - GIS layers
    - Routes (lines)
    - Stops
    - Census Blocks, Block Groups, Tracts, ZIP Code Tabulation Areas (ZCTA)
  - Ridership data
  - Census data
    - American Community Survey demographic and economic data
    - Economic Census data
      - ZIP Code Business Patterns

# Example: Santa Clara Valley Transportation Authority (VTA) - <http://www.vta.org/>

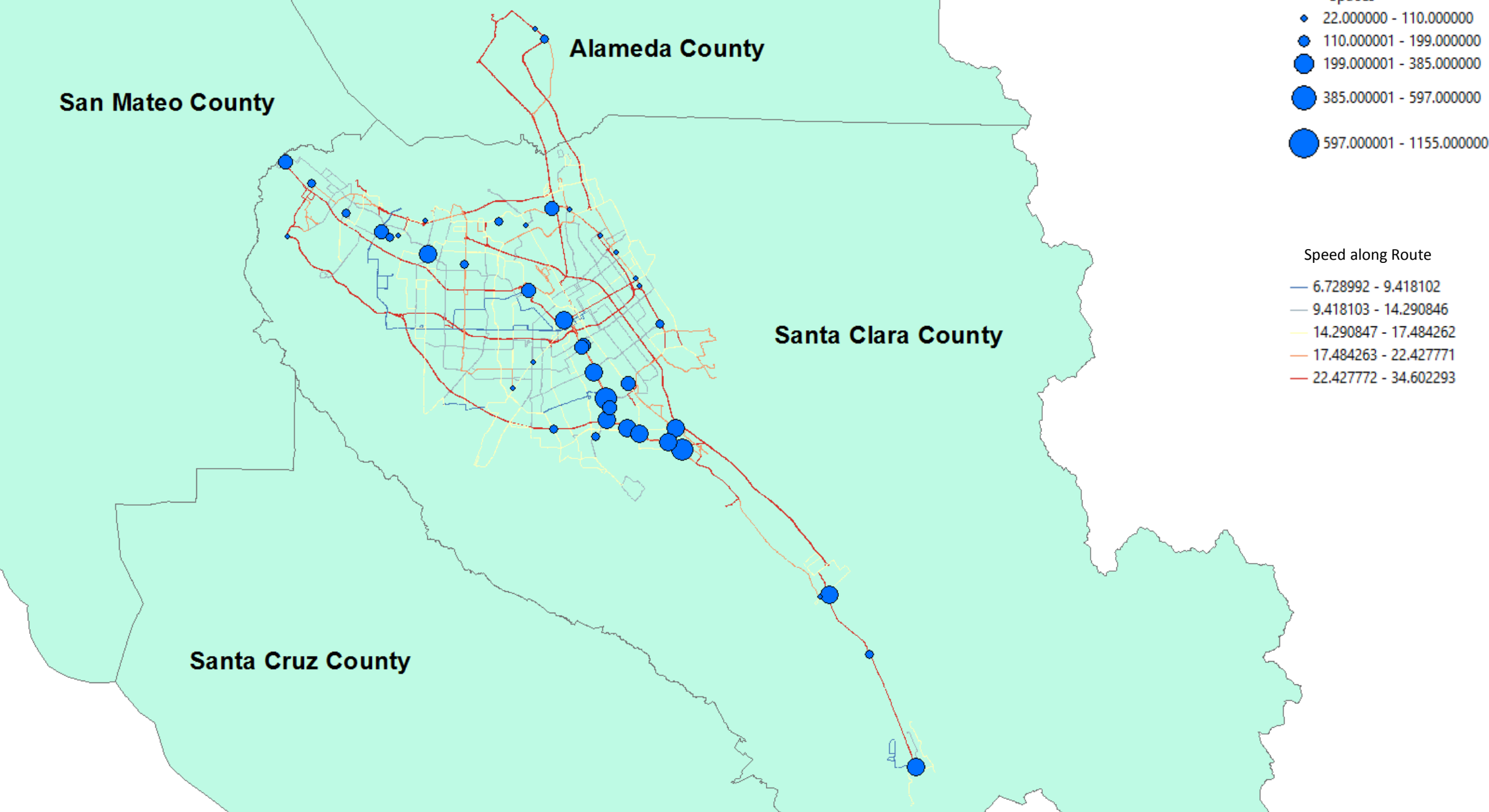
- Overview

- 70 routes including bus and light rail
- 3,960 stops
- 43 park-and-ride lots, of which:
  - 14 are CalTrain (commuter train) lots
  - 3 are CalTrans lots
  - 26 are VTA lots
- Total Spaces in Park-and-Ride lots: 11,941 ranging from 22 spaces to 1,155 spaces

# VTA Routes, Stops, and Park-and-Ride Lots

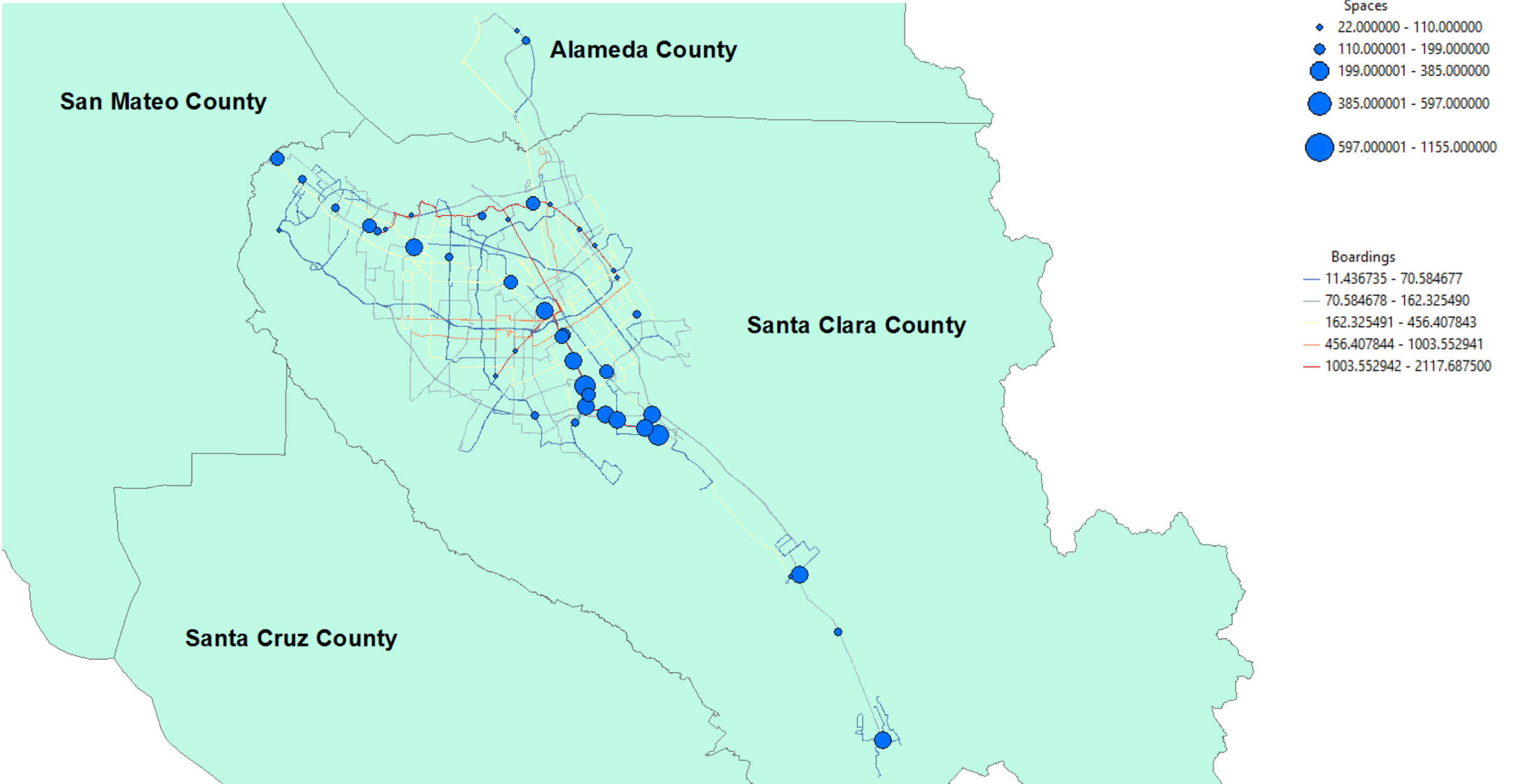


# VTA Routes by Speed Along Route and Size of Park-and-Ride Lots

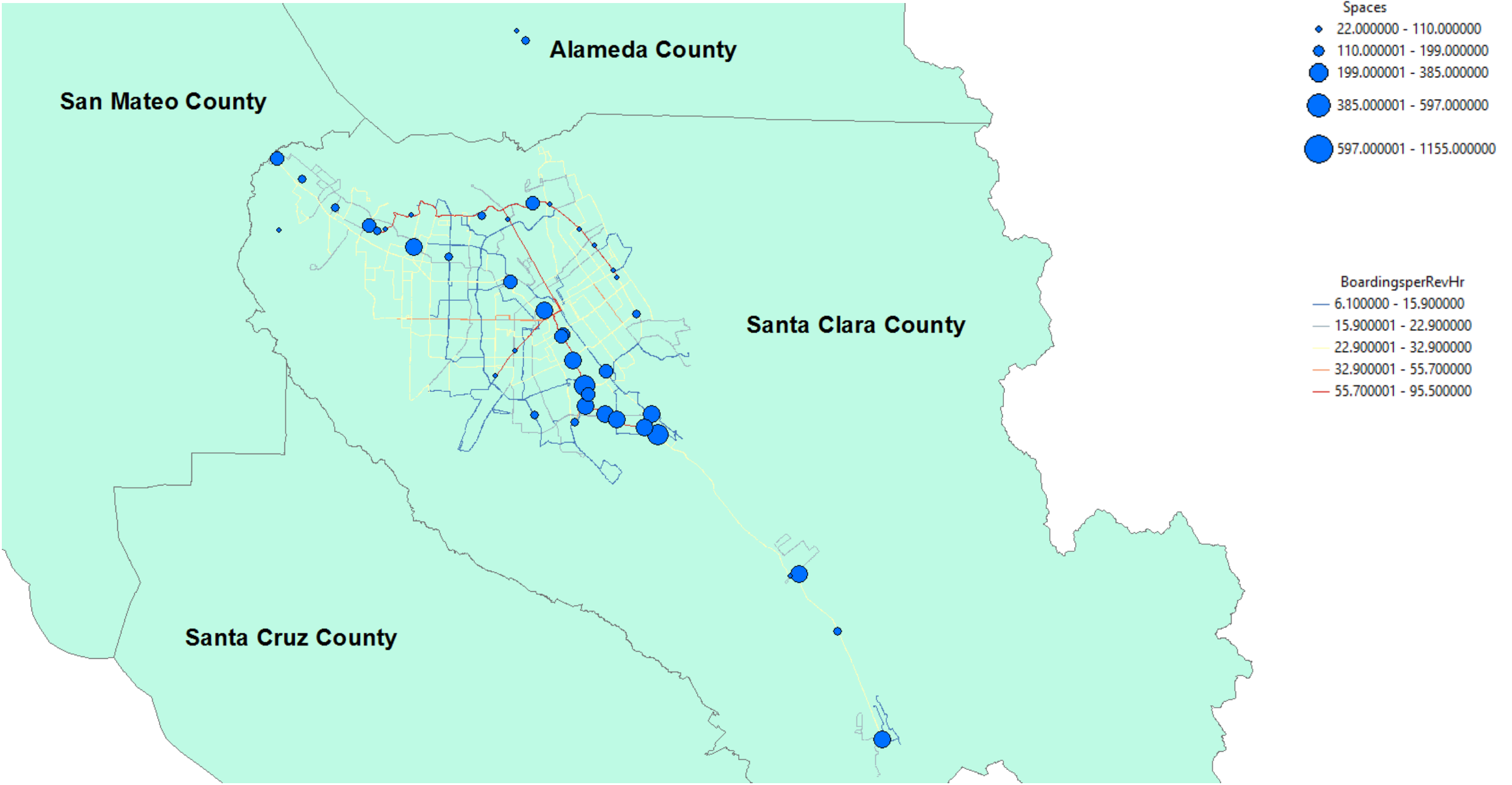




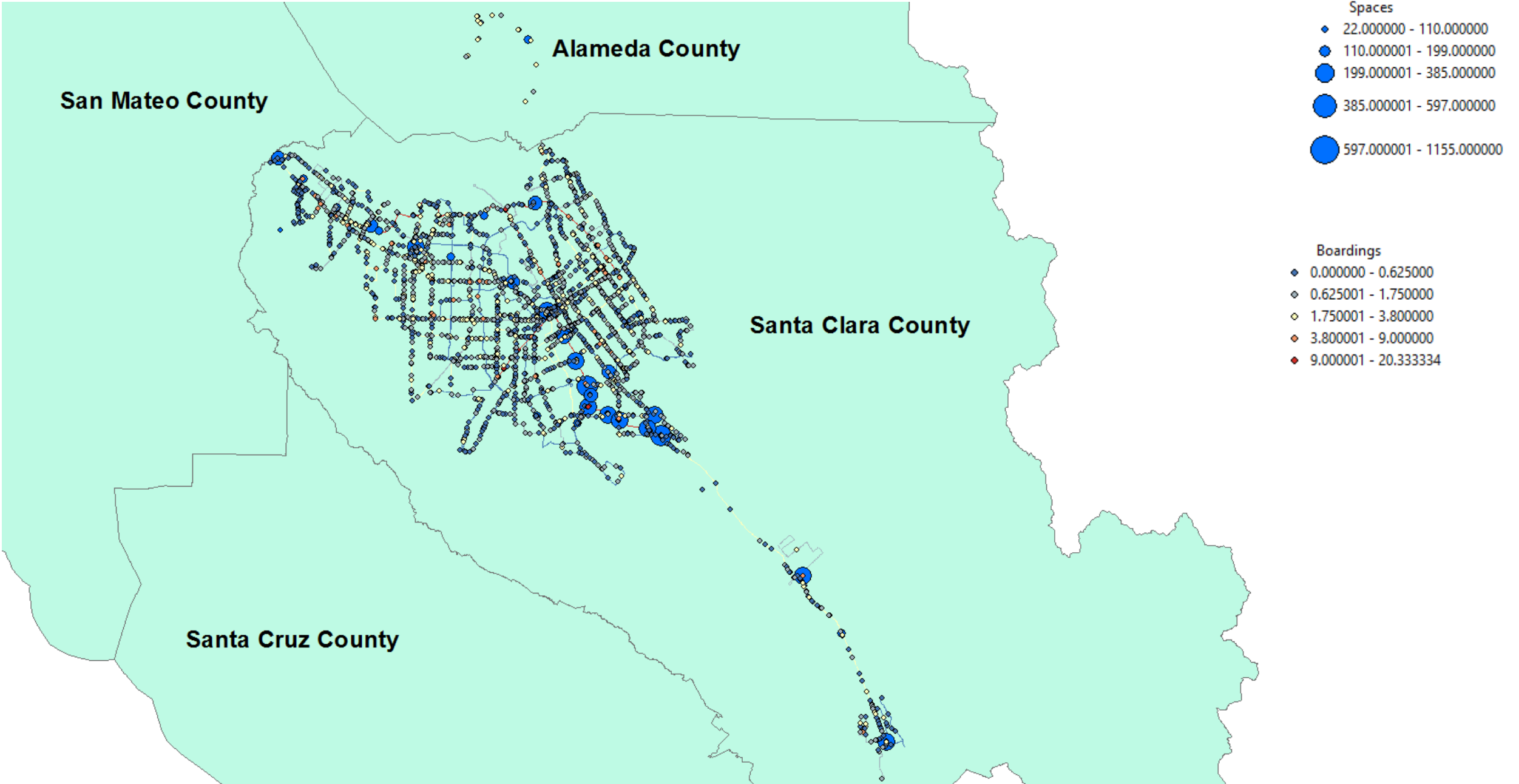
# VTA Routes by Boardings Along Route and Size of Park-and-Ride Lots



# VTA Routes by Boardings per Revenue Hour and Size of Park-and-Ride Lots



# VTA Stops by Boardings and Size of Park-and-Ride Lots



# OLS Stop-Level Regression with Quarter Mile Dummy

Source	SS	df	MS	Number of obs	=	2,330
Model	609.836347	3	203.278782	F(3, 2326)	=	80.46
Residual	5876.69994	2,326	2.5265262	Prob > F	=	0.0000
Total	6486.53629	2,329	2.78511648	R-squared	=	0.0940
				Adj R-squared	=	0.0928
				Root MSE	=	1.5895

MAX_Boardings	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
QuarterMileDummy	1.486799	.1181965	12.58	0.000	1.255018 1.718581
MEAN_B19013e1	-2.19e-06	1.01e-06	-2.17	0.030	-4.17e-06 -2.11e-07
popdens	3.354976	.4586086	7.32	0.000	2.455652 4.254301
_cons	1.124528	.1128618	9.96	0.000	.9032077 1.345848

Mean of Median HH  
income within quarter  
mile of stop



population density within  
quarter mile of stop



# OLS Regression with Quarter Mile Capacity Variable

Source	SS	df	MS	Number of obs	=	2,330
Model	469.283349	3	156.427783	F(3, 2326)	=	60.47
Residual	6017.25294	2,326	2.58695311	Prob > F	=	0.0000
Total	6486.53629	2,329	2.78511648	R-squared	=	0.0723
				Adj R-squared	=	0.0712
				Root MSE	=	1.6084

MAX_Boardings	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
QuarterMileCapacity	.0026318	.0002629	10.01	0.000	.0021163	.0031474
MEAN_B19013e1	-2.40e-06	1.02e-06	-2.35	0.019	-4.41e-06	-4.02e-07
popdens	3.401208	.4644748	7.32	0.000	2.49038	4.312036
_cons	1.191251	.1138732	10.46	0.000	.9679474	1.414554

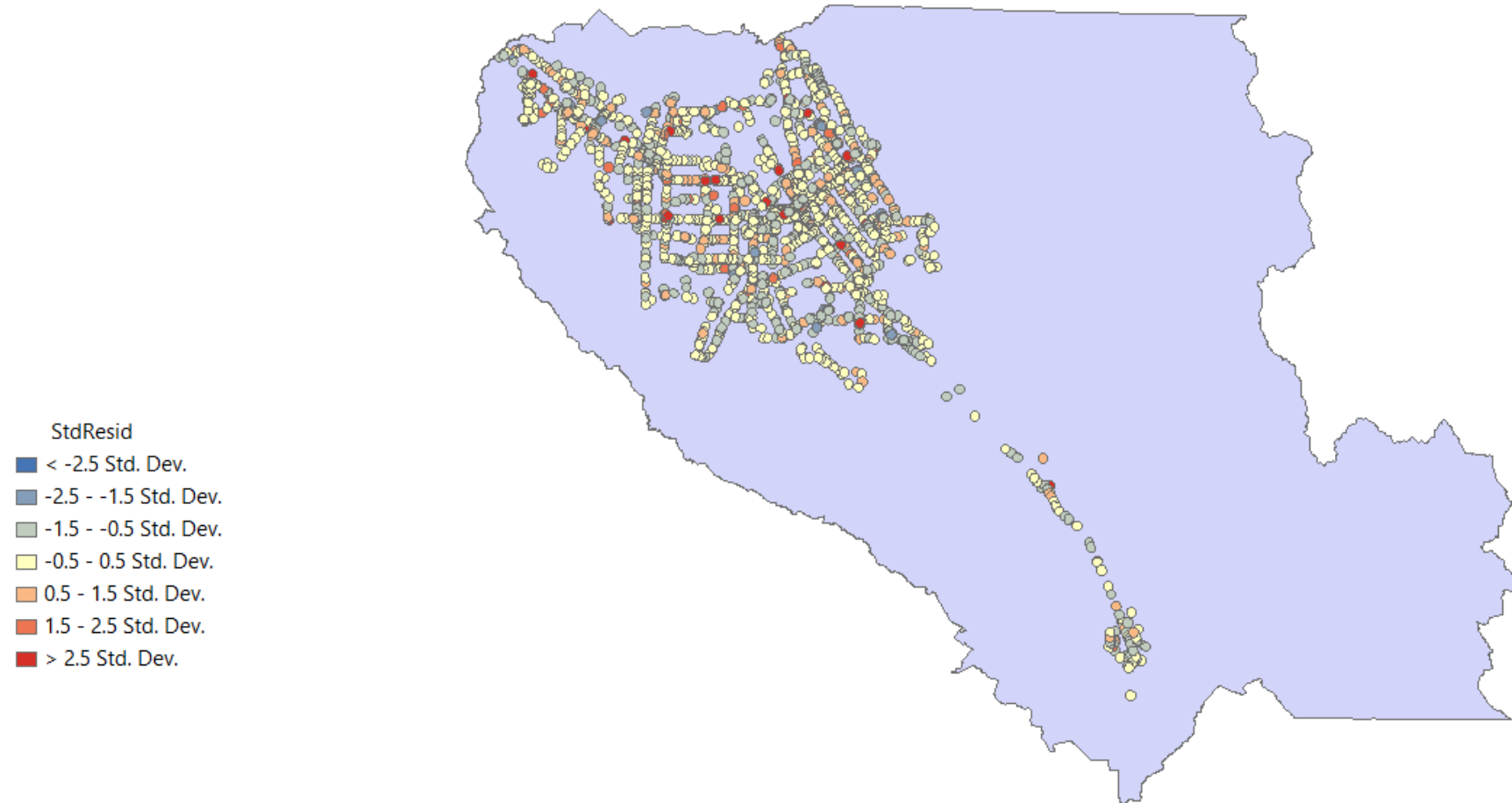
Mean of Median HH  
income within quarter  
mile of stop



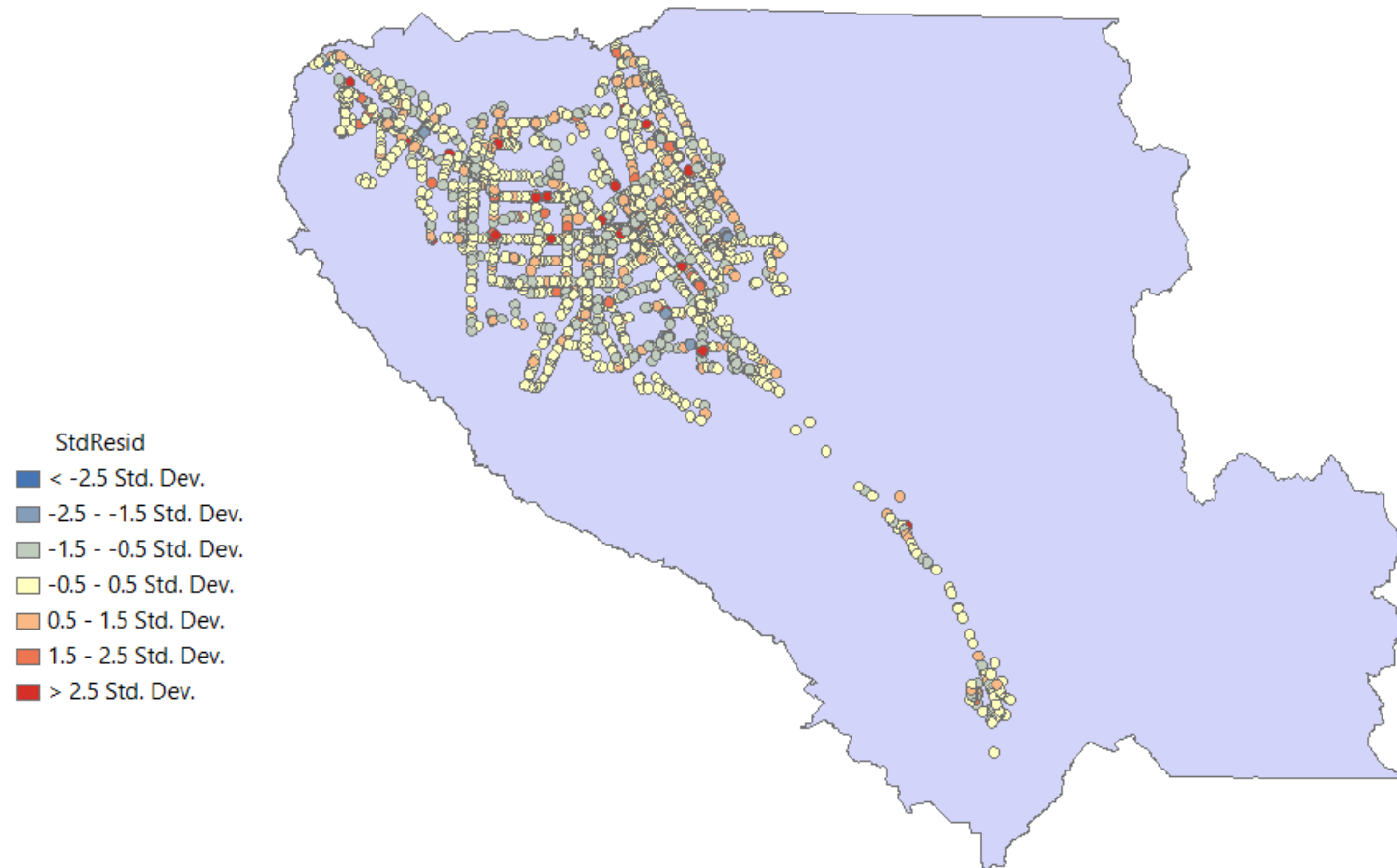
population density within  
quarter mile of stop



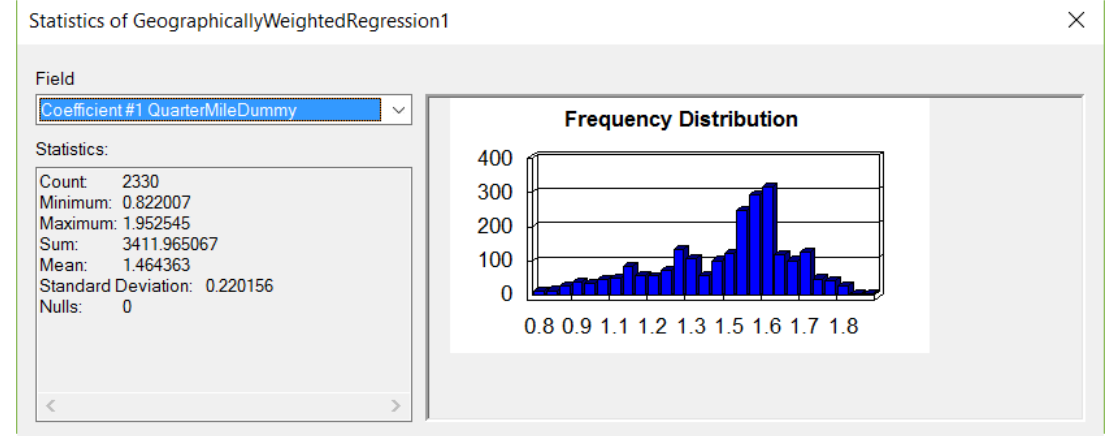
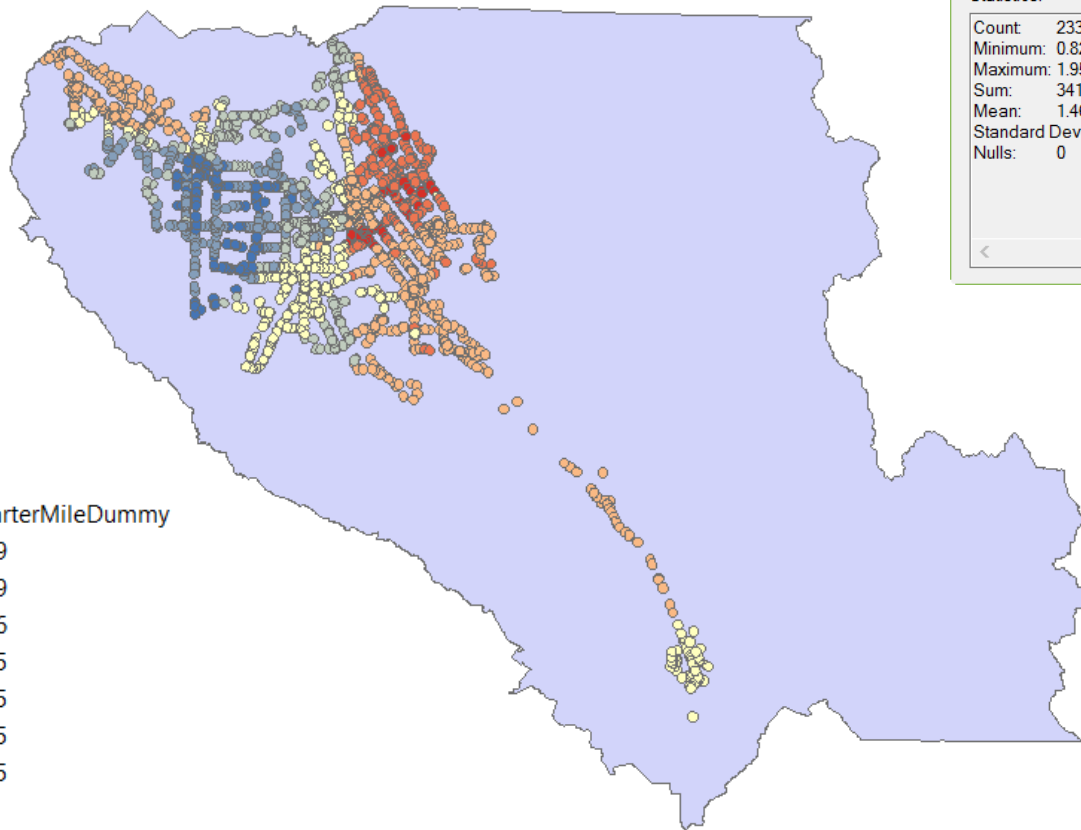
# Distribution of Residuals from GWR with Quarter Mile Dummy



# Distribution of Residuals from GWR with Quarter Mile Capacity

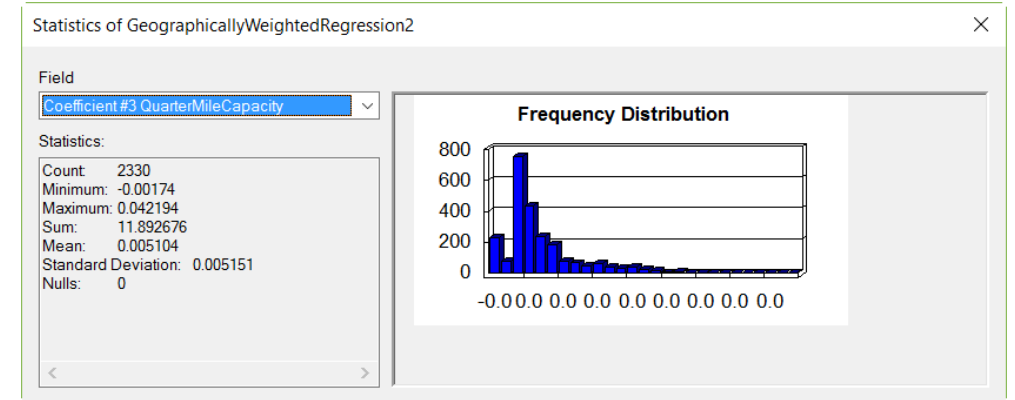
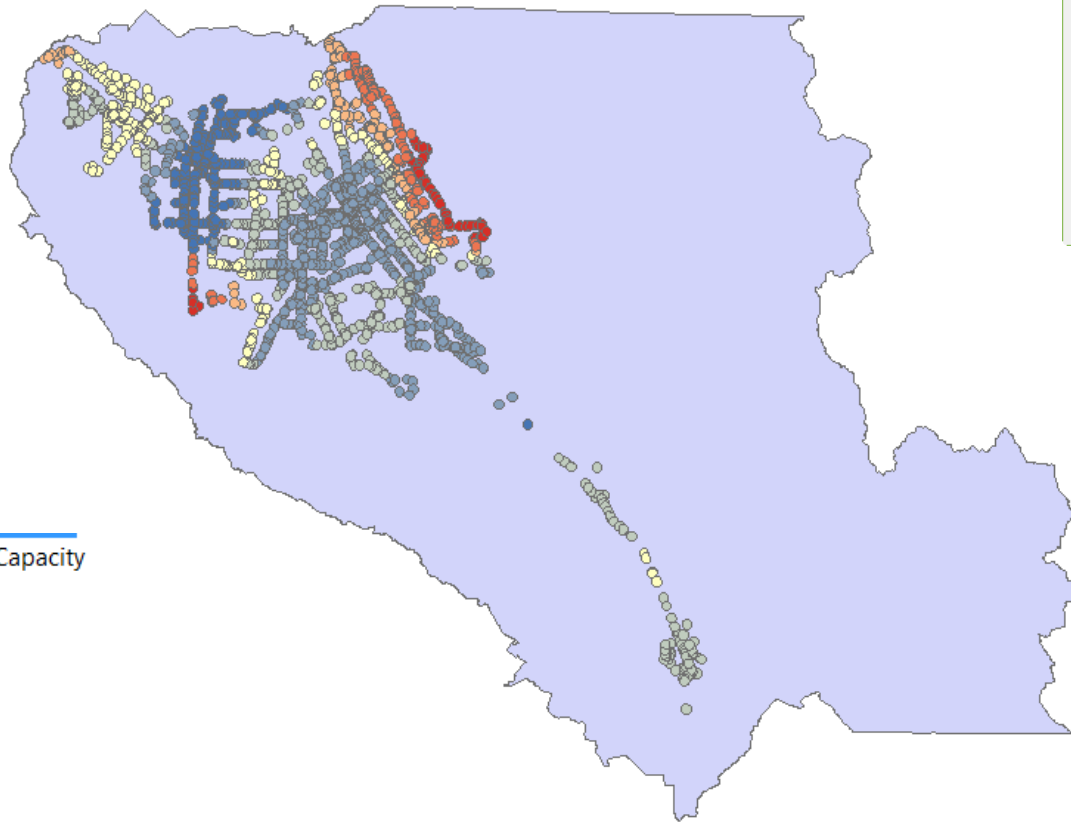


# Distribution of Coefficient Estimates on Quarter Mile Dummy from GWR





# Distribution of Coefficient Estimates on Quarter Mile Capacity from GWR



# Types of Service

line_type	Freq.	Percent	Cum.
Community Bus	16	22.86	22.86
Core	18	25.71	48.57
Express	12	17.14	65.71
Light Rail	3	4.29	70
Limited	4	5.71	75.71
Local	17	24.29	100
Total	70	100	

# OLS Route-Level Results

Source	SS	df	MS	Number of obs	=	70
				F(6,63)	=	85.27
Model	15874.9001	6	2645.81668	Prob>F	=	0
Residual	1954.90955	63	31.0303103	R-squared	=	0.8904
				AdjR-squared	=	0.8799
Total	17829.8096	69	258.403038	RootMSE	=	5.5705
BoardingsperRevenueHr	Coef.	Std.Err.	t	P>t	[95%Conf.	Interval]
TotalOfQUANTITY	0.0003964	0.000341	1.16	0.249	-0.000285	0.0010778
CommunityBus	-7.46194	1.953654	-3.82	0	-11.36601	-3.557875
Core	3.703044	1.91677	1.93	0.058	-0.1273162	7.533404
Express	-23.05537	2.143444	-10.76	0	-27.3387	-18.77204
LightRail	51.55787	3.597547	14.33	0	44.36875	58.747
Limited	-9.223843	3.096225	-2.98	0.004	-15.41116	-3.036531
_cons	23.04288	1.420494	16.22	0	20.20425	25.88151
HoldoutTypeofService:Local						

# Questions or Comments?

Mike Pogodzinski

Department of Economics

San Jose State Universtiy

[j.m.Pogodzinski@gmail.com](mailto:j.m.Pogodzinski@gmail.com)