Where Do We Need More Electric Vehicle Charging Stations? Visualizing Supply Demand by Zip Codes

Caleb Rauscher, Mariam Ilyas, Mojtaba Taghipour Kaffash, Robert Krawczak, and Sam Yarney

Motivation

The switch to electric vehicles (EVs) requires adequate public charging infrastructure. Which areas are most in need? Our project shows the geographic areas (zip codes) where the ratio of available public charging stations to registered EVs is the least, areas most in need of additional charging infrastructure.

Innovations

- All data sets are public – other studies included attitude surveys to estimate adoption rate of EV's
- Cover continental United States – other studies focused on a single metro area or single state
- Use actual EV registration numbers to estimate number of EV's in a zip code where public registration data is not available – no studies for states where registration information was not public

Data Sets

We selected public data sets, all available to download

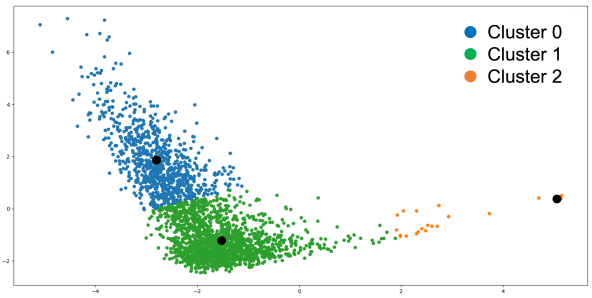
- *Existing EV Charging Stations* – From US Department of Energy
- *Census demographic profiles* – From the American Community Survey, done and maintained by the US Census Bureau.
- *EV registration by zip code, county* – Collected and made available by Atlas EV hub, data supplied by participating states

The sources above were combined into a master modeling data set with zip code as the primary key. After data wrangling and feature selection the master dataset contained 39290 rows (zip-codes) and 544 columns (features + num of EVs registered as the label)

Approach

- Use actual EV registration numbers where available to label zip codes for EV demand
- Cluster labeled zip codes on demographic factors to form groups of similar zip codes
- Build regression models for each cluster to estimate EV adoption based on demographic factors
- Add unlabeled zip codes to cluster, grouping with areas of similar demographics
- Use the regression models in each cluster to impute EV registration estimates to each unlabeled zip code
- Calculate and display ratio of supply(chargers) / demand (EVs) for each zip code

Cluster Labeled Zip Codes

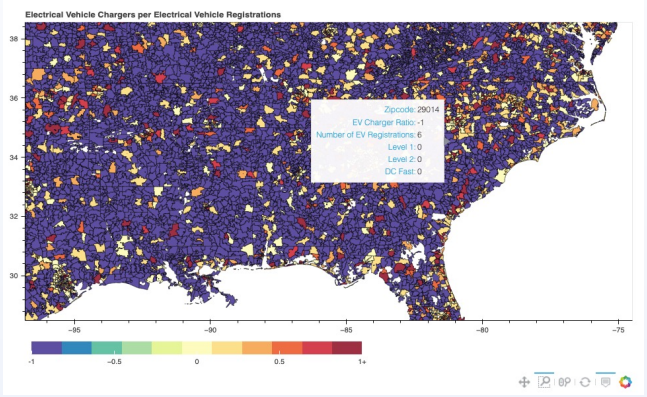


Three clusters showing labeled zip codes with similar census profiles. Next, we assigned unlabeled zip codes to the most similar demographic and economic profile.

Regression Model for Each Cluster to Estimate EV Registration in Non-labeled Zip-codes

	Cluster 0	Cluster 1	Cluster2
MSE (train)	16713	16713	16713
MSE (test)	11449	171	1443
R.SQ (train)	0.18707	0.18707	0.18707
R.SQ (test)	0.18679	-1.05960	0.45594

Results



Map showing tool tip for zip code. Red areas have the highest ratio of public charging stations to registered EV.

Conclusions

- Large portion of the country showing no chargers with at least 1 EV registered. These maybe using in-home chargers.
- Real demand may need to go lower than zip-code level
- Businesses and attractions may be as good or better predictors for EV adoption than local demographics
- Will be interesting to see how demand and chargers change after Ford introduces the Lightning F-150 electric pick-up truck