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Sociology 765
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The Role of Education in Promoting Environmentally Sustainable Behavior

I. Introduction

While policymakers around the country argue over the validity of climate change, municipalities of varying sizes and wealth are attempting to promote sustainable practices within their communities. Policies which emphasis sustainability, however, are often times expensive and politically polarizing, which creates challenges for smaller municipalities who haven't either the financial means or legal authority to pass substantial environmental policies. In cases where communities are unable to mandate sustainable policies due to their political unfeasibility or financial cost, a possible alternative may lie in indirectly promoting sustainability by investing in policies which are both affordable and politically uncontroversial and which result in individuals making more sustainable choices. This paper aims to see if it is possible to indirectly promote sustainability through investments in education. Specifically I hope to see if higher levels of education results in a greater number of county residents making the decision to purchase an electric vehicle. For my paper I will be specifically analyzing county-wide data in New York State.

Due to the current state of political paralysis in the United States it is near impossible for states and local communities to depend on the federal government to enact sweeping environmental sustainability policies. International studies, however have shown that educational attainment plays an important role in promoting environmental consciousness (Lee). In a 2017

Pew Research Center study conducted in Latin America, it was found that educational attainment showed a stronger positive correlation to levels of environmental awareness than wealth (Evans). Past research has also shown that farmers' markets serve as education centers for ecological sustainability and environmental justice (Alkon). Both higher education and farmers' markets have widespread political support and currently receive considerable financial support on both the state and federal levels. If greater investments in these affordable and politically neutral programs encourages individual to make the environmentally sustainable choice of purchasing an electric vehicle, then local municipalities can be proactive and take steps towards mitigating the effects of climate change within their communities.

II. Methodology

I have created my dataset by compiling data from various sources such as Open Data NY, New York State Department of Health, U.S. Bureau of Labor Statistics and the U.S. Department of Agriculture. The dependent variable I have selected is the number of electric vehicles purchased per county. This data was obtained through Open Data NY. This variable will serve as the environmentally sustainable behavior which local government may wish to promote.

For my education independent variables I have selected two measures. The first is percentage of residents with a college degree. This data was obtained through the U.S. Department of Agriculture which provides the number of residents with a college degree in New York State on a county level. I hope to analyze whether counties which have a greater percentage of college graduates also have a greater number of electric vehicle owners. Since education and income often to go hand in hand, I intend to use income as a control variable. For my analysis I will be utilizing New York State average weekly income per county data from the U.S. Bureau

of Labor Statistics. I will attempt to see if educational attainment has a stronger correlation with rates of electric vehicle ownership than income.

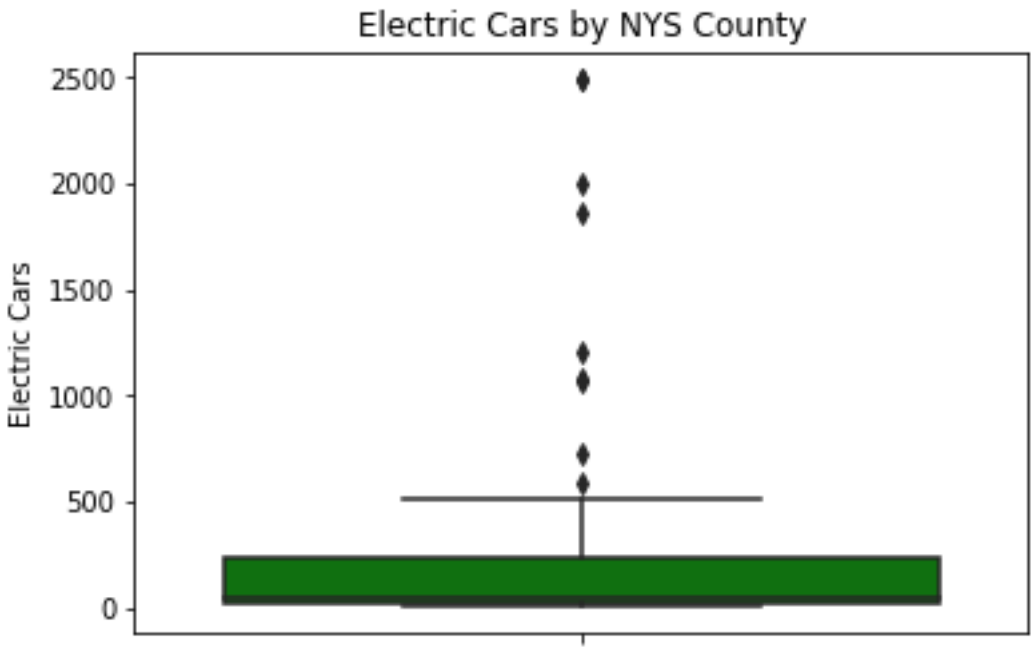
My second education dependent variable is the number of farmers' markets per county. This data was retrieved from Open Data NY. The dataset shows that all New York State counties should have access to at least one farmers' markets and most counties have several. Their popularity has dramatically increased in recent years. While Americans may be extremely polarized with regards to their views of climate change and what actions should be taken in response, there are very few Americans who would argue against supporting more farmers market or more college graduates. If there is in fact a positive correlation between these two variables and electric car ownership, local communities may be able to hit two birds with one stone. By further promoting these already popular educational policies they may also indirectly promote environmental sustainability.

III. Results

A. Summary Statistics and Data Visualization

- Per County Electric Vehicle Ownership in New York State

There is currently a total of 18,008 electric vehicles in the state of New York. On average there are 290 electric vehicles per New York State counties, while the median per county number of electric vehicles is 42 with a standard deviation of 42.5 vehicles. This dramatic difference between the average and median number of electric vehicles per county suggests a considerable positive skew in the distribution of electric vehicles amongst the various NYS counties. For a better visualization of this skew the following boxplot presents the distribution of electric vehicles amongst the various counties in New York State.



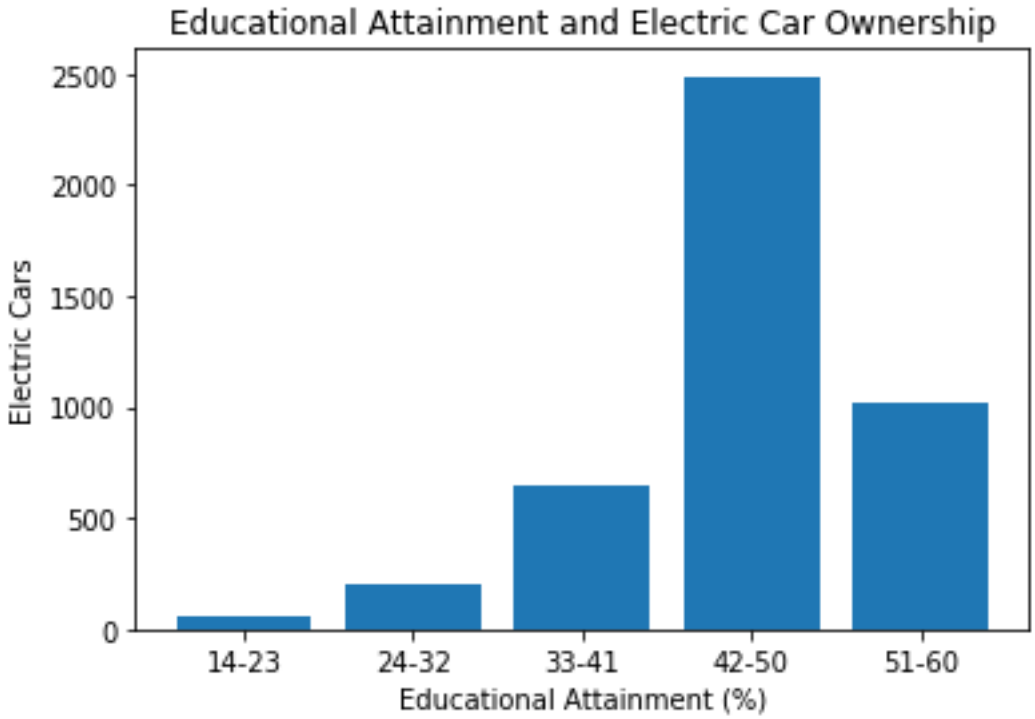
As the boxplot shows, the vast majority of New York State counties have significantly less than 250 electric cars, but there are several outlier counties that fall far outside the upper limit of the boxplot. The county with the most electric vehicles is Westchester County with a total of 2,490 electric vehicles, which is 10 times the average and nearly 60 times the median number. In contrast the county with the least number of electric vehicles is Hamilton County with only 7 electric vehicles.

To have a clearer understanding of how these two counties differ from each other it is useful to compare their demographic and socioeconomic measures. Westchester has a population of just under 1 million residents and while considerably larger than Hamilton, which has less than 5 thousand residents, it is not the most populated county in New York State. That title goes to Kings County with over 2.5 million residents. The average weekly income in Westchester is just over $1,300 compared to Hamilton with an average weekly income of $774. The wealthiest county in New York State, however, is New York with an average weekly income of nearly

$2,000. Lastly, Westchester County's unemployment rate stands at 3.2 percent which is over 10% below the state average of 3.6%. In contrast, the unemployment rate in Hamilton County is 6.8% which is nearly double the state average. These statistics indicate that Westchester County considerably dwarves Hamilton County demographically and with regards to its socioeconomic status.

Having compared these two counties by various economic measures, they can now be compared by the education variables of this study. Our first education variable is educational attainment, which is represented by the percentage of residents in a county with a Bachelor's degree or more. On average, 26% of New York State residents have a college degree or more. In Westchester County, however, 47% of residents currently have a Bachelor's degree or higher which is nearly 3 times that of Hamilton County at 17%.

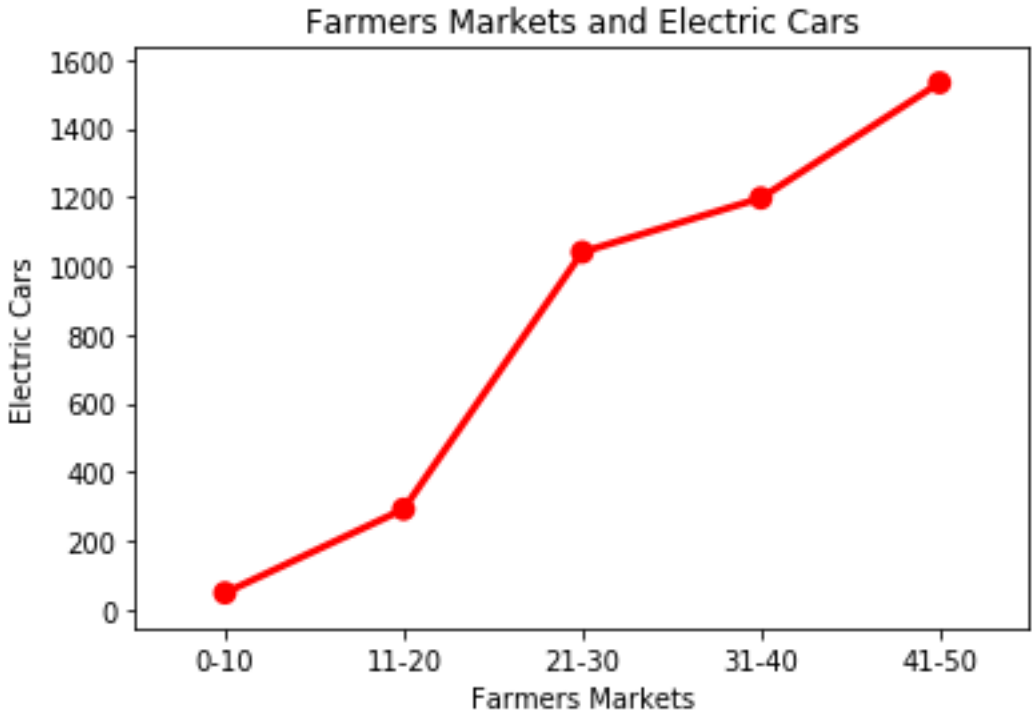
To better understand the relationship between educational attainment and electric car ownership, the following bar graph depicts the interaction of these two variables. In this graph, counties were grouped into five different levels of educational attainment and then the average number of electric cars in each level was calculated and compared. The graph shows that increased levels of educational attainment results in increased levels of electric car ownership up to a certain point. There is a considerable decline in the number of car ownership between the counties where 42-50 percent of residents have Bachelor's degrees or more and those with over 50 percent college graduates. This result is confirmed by the fact that New York County, which had the highest rate of college graduates at 60 percent had nearly 600 fewer electric vehicles than Westchester County.



My second education independent variable is the number of farmers markets in a county. On average, there are 12 farmers markets per NYS County. Westchester County currently has a total of 32 farmers markets, which is over 4 times more than Hamilton County which has 7, though significantly less than Kings County, which had the greatest number of farmers markets at 50.

The last graph looks at the relationship between the number of farmers markets in a county and the number of electric vehicles. As I did with my educational attainment variable, I divided the counties into 5 categories based on the number of markets in each county. The average number of farmers markets per group was calculated and then compared. There is a

strong positive correlation between farmers markets and electric car ownership and unlike our variable, educational attainment, at now point do we see a dramatic reversal of this relationship.

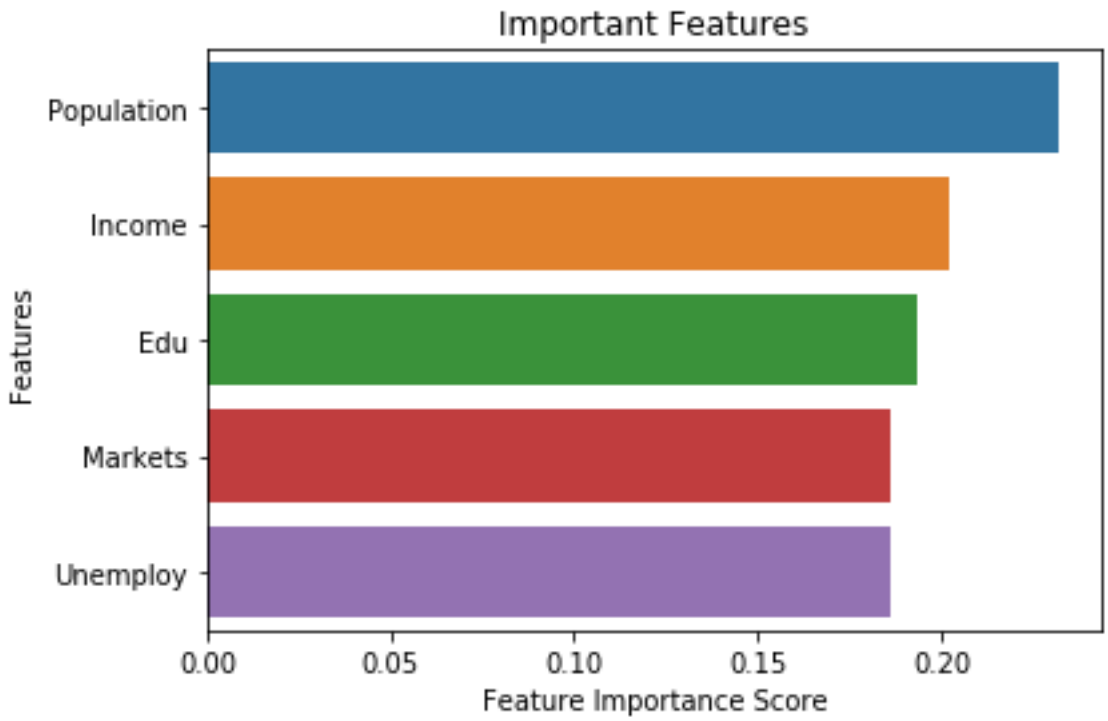


These two graphs suggest that education does seem to play some role in influencing the decision of New York State residents to purchase an electric car. Future analysis, however, should focus on the degree in which these two variable are directly influencing this behavior and to what extent other variables such as income may be intervening.

B. Exploratory Analysis

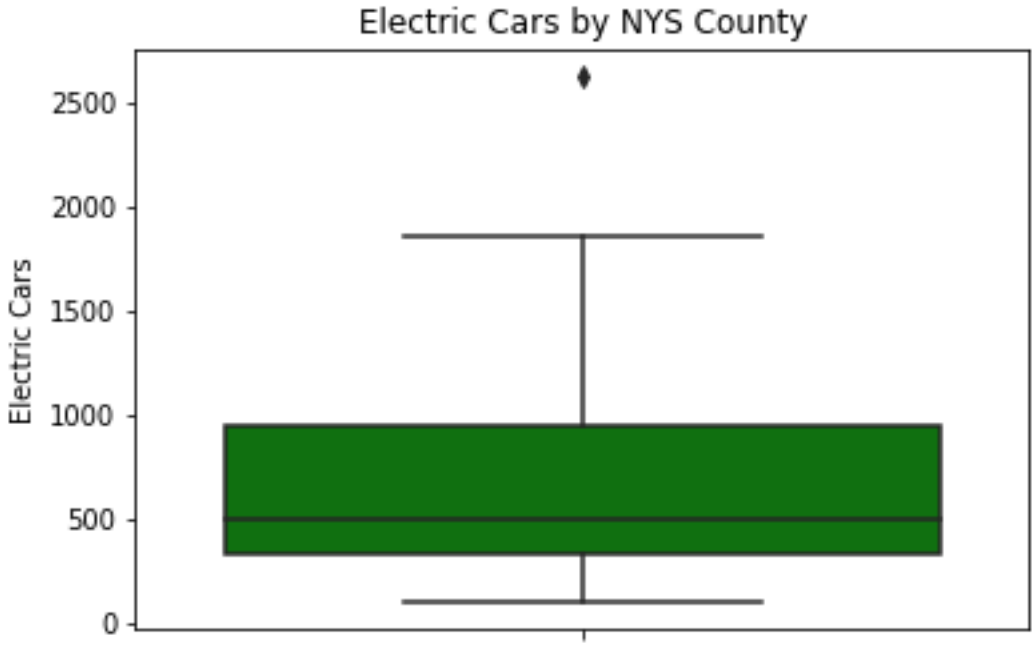
For the last portion of my results section I will be performing several linear regression analyses on my education variables. Before doing this, however, it is good to have an understanding of what other variables are having an effect on electric car ownership and if possible, control for these variables. To do this I have utilized the RandomForestClassifier

feature of the sklearn.ensemble package in python to run a feature selection analysis. In this analysis, I have included all the variables in my dataset that may have an effect on electric car ownership rates. In addition to my education variables of educational attainment (Edu) and farmers markets (Markets), other variables which have been included are income, population, and unemployment (Unemploy). The following graph illustrates the results of the feature selection analysis.



Not surprising, population is the variable which seems to most strongly influence electric car ownership. More people in a county would naturally result in more cars of any variety. In order to control for population and isolate the effects of our education variables I have created a per capita measure of the electric car variable. I have done this by dividing the number of electric cars per county by the county population and multiplying the result by 100,000. The boxplot for

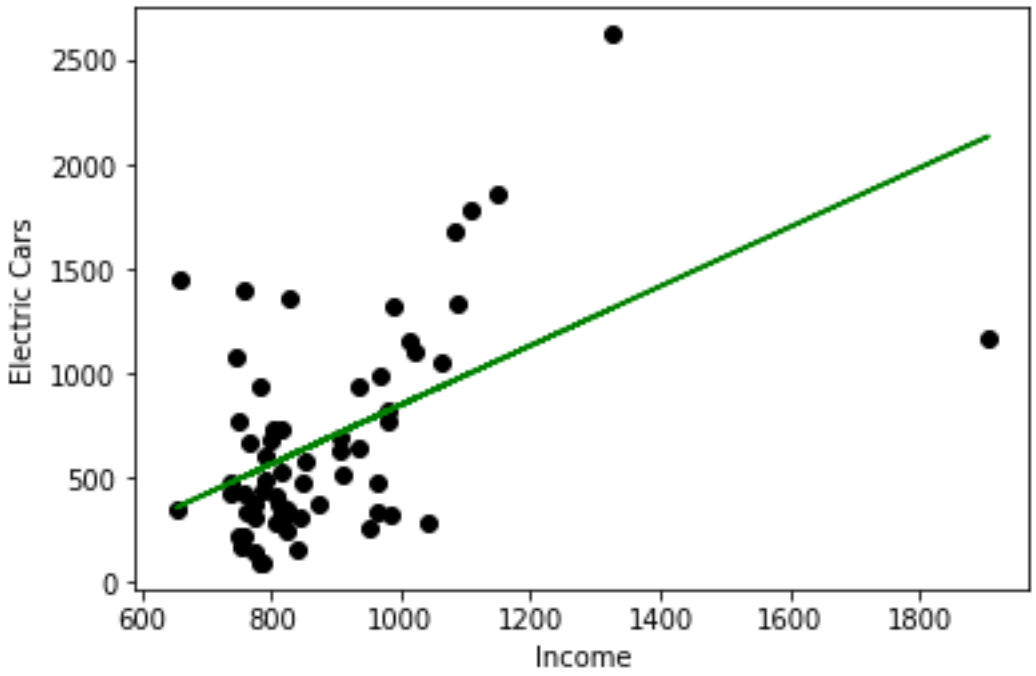
the new variable, Per Capita Electric Cars (EV_PC) looks considerably different to the last Electric Cars boxplot. The number of outliers has been significantly reduced.



Aside from populations, the three significant variables according to our feature selection graph are income, educational attainment and farmers market. The following three simple linear regression analyses will measure the relationship between these three independent variables and electric car ownership.

Income and Electric Cars

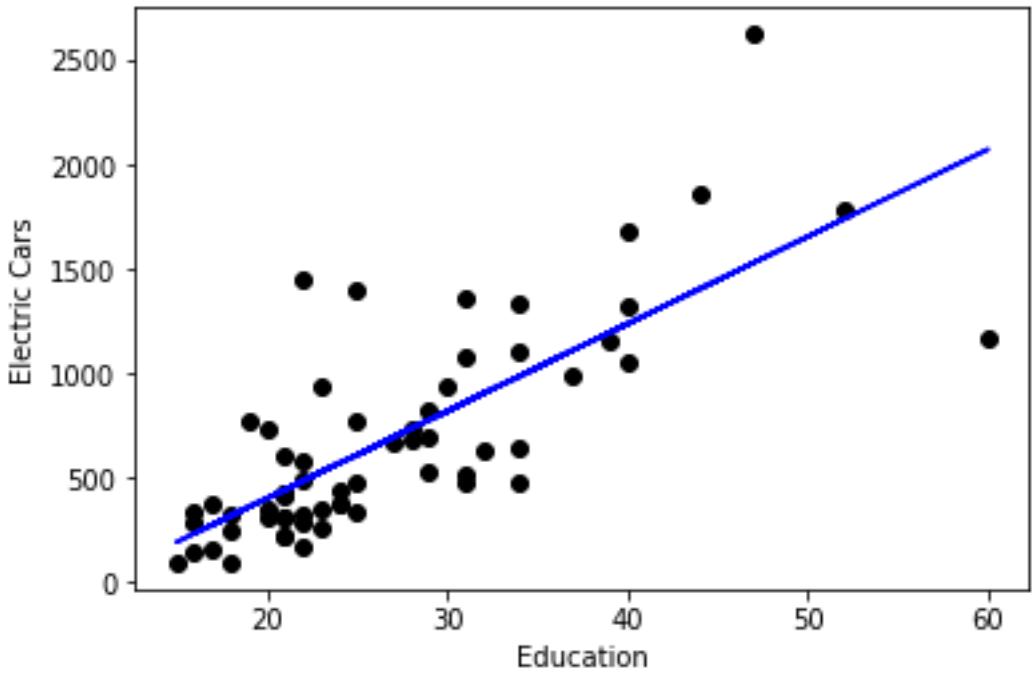
The first simple linear regression looks at income and electric car ownership. It shows that every dollar increase in per capita weekly income resulted in an increase of 1.41 electric cars. This suggests that county income plays a strong role in determining the number of electric cars in a county.



intercept [-567.4968211]
slope [[1.4183995]]

Educational Attainment and Electric Cars

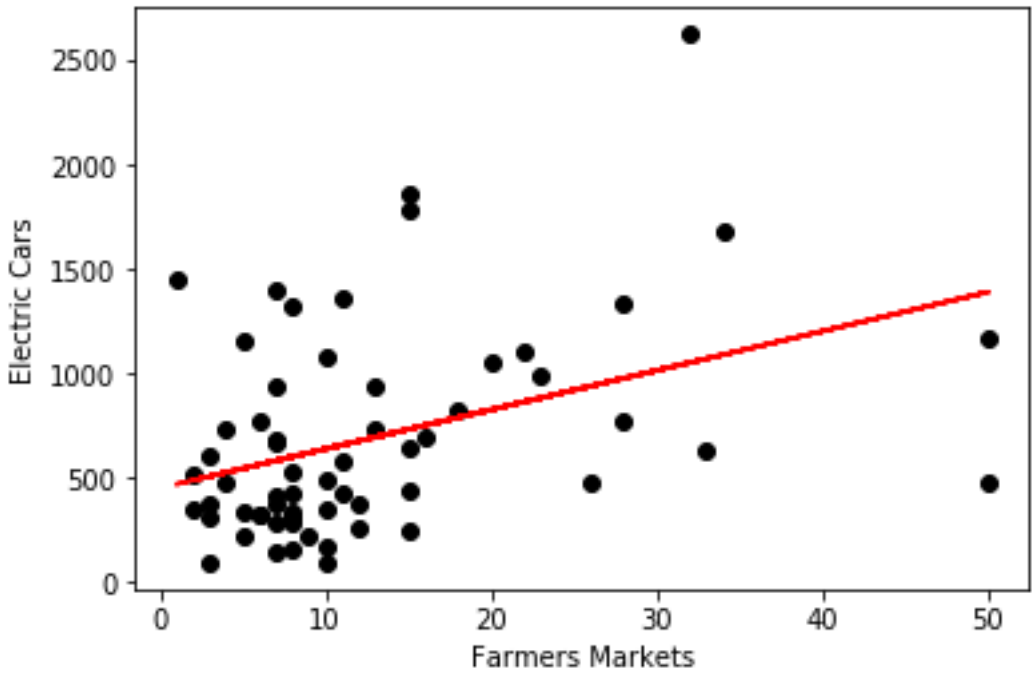
The second simple linear regression looks at the relationship between educational attainment and electric cars. It finds that every 1 percent increase in per county college graduates resulted in an increase of 41 cars. Like income, educational attainment also appears to be a significant factor in determining how many electric cars a county has.



intercept [-435.4694876]
slope [[41.84783889]]

Farmers Markets and Electric Cars

The last simple linear regression looks at the relationship between the number of farmers markets per county and electric cars. The results shows a less significant relationship compared to income and educational attainment. Every additional farmers market resulted in an additional 19 electric cars.



intercept [451.27765365]
slope [[18.80359416]]

Multivariate OLS Regression

In order to isolate the effect of each variable on the number of electric cars, I have run a multivariate OLS regression. The results show that when holding all other variables constant, the effects of educational attainment actually increases. The new regression results show that every 1 percent increase in the number of college graduates results in an increase of 51 electric cars. The effects of both income and farmers markets, however, completely disappear when holding all other variables constant.

OLS Regression Results

Dep. Variable:	EV_PC	R-squared:	0.857
Model:	OLS	Adj. R-squared:	0.850
Method:	Least Squares	F-statistic:	118.2
Date: Sat, 11 May 2019		Prob (F-statistic):	6.48e-25
Time: 13:20:51		Log-Likelihood:	-445.74
No. Observations:	62	AIC:	897.5
Df Residuals:	59	BIC:	903.9
Df Model:	3		
Covariance Type:	nonrobust		

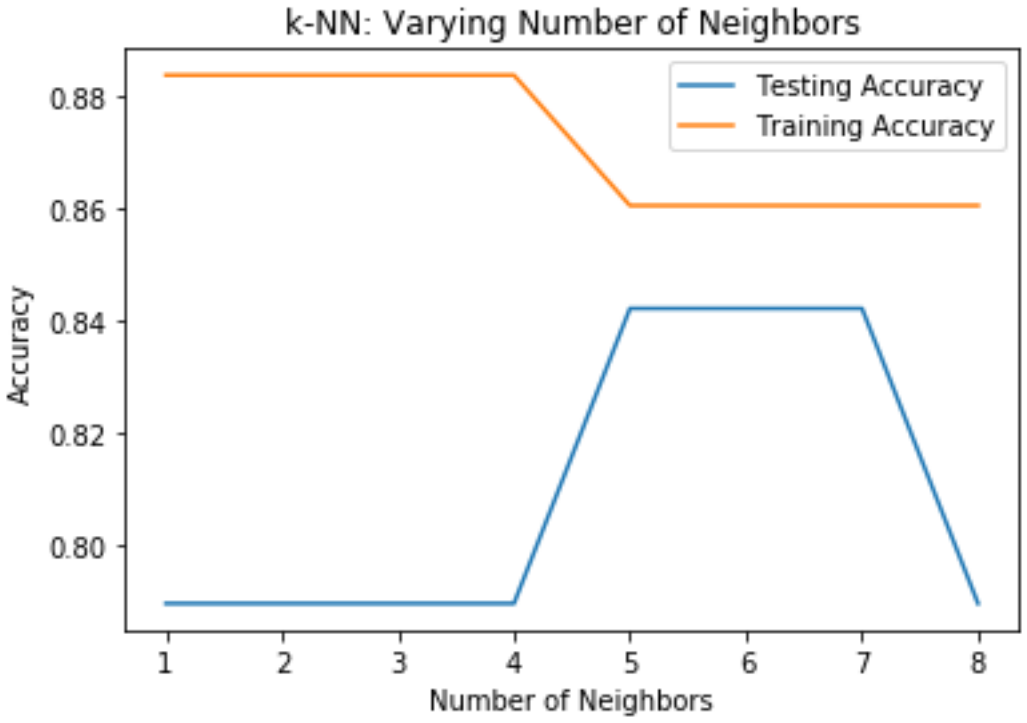
	coef	**std err**	**t**	**P>|t|**	**[0.025**	**0.975]**
Edu	51.6371	7.342	7.033	0.000	36.945	66.329
Markets	-1.5162	4.963	-0.305	0.761	-11.447	8.415
Income	-0.7576	0.219	-3.462	0.001	-1.196	-0.320

Omnibus:	26.118	Durbin-Watson:	2.234
Prob(Omnibus):	0.000	Jarque-Bera (JB):	44.232
Skew:	1.483	Prob(JB):	2.48e-10
Kurtosis:	5.886	Cond. No.	165.

Testing Model Accuracy

The OLS regression results suggest that are most significant variable is educational attainment when predicting the number of electric cars per county. To test the accuracy of this model, I will be utilizing the KNeighborsClassifier feature of the sklearn.neighbors package. I converted my Per Capita Electric Cars variable into an ordinal variable in which counties with 1 to 833 electric cars were labeled “Low”, counties with 834 to 1,663 cars were labeled “Mid-Range” and counties with 1,664 or more were labeled “High”. I then selected educational attainment as my independent variable and per capita electric cars as my dependent variable. After splitting my data into training and testing sets, I tested my model with an n_neighbors of 3 with a resulting accuracy score of **0.78947368421052633**

To ensure that I selected the best n_neighbor for my model I plotted a model complexity curve. The results show that the model reaches its highest level of accuracy with an n_neighbor of 5 to 7. Re-running my model with an n-neighbors of 6, my accuracy score increases to **0.84210526315789469**, which indicates a fairly accurate model.



IV. Discussion and Conclusion

While a comprehensive, Federal response to climate change is desperately needed, local communities shouldn't feel that they must wait helplessly for the political headwinds to change. By promoting policies which are both affordable and politically attainable they may be able to also promote environmentally sustainable behavior by their local residents. This exploratory analysis has found a strong positive correlation between education and sustainable behavior, which opens the door to new policy initiatives that take advantage of this relationship. An

example of this could be encouraging colleges and universities to add a course on climate change and sustainability to their list of required courses. Additionally, information booths which provide information regarding energy efficiency home upgrade options and government energy efficiency incentive programs can be set up at all farmers markets. These actions would be extremely affordable and uncontroversial, while encouraging sustainability.

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