Prediction of Alternative Fuel Vehicle Adoption

2017 NHTS Case

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1 Introduction

2 Data

3 Methodology

4 Results

5 Conclusion

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3 Methodology

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Research Objectives

- Explore the Influencing Factor on AFV adoption.

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- Compare between parametric and non parametric ML models predictive performance.

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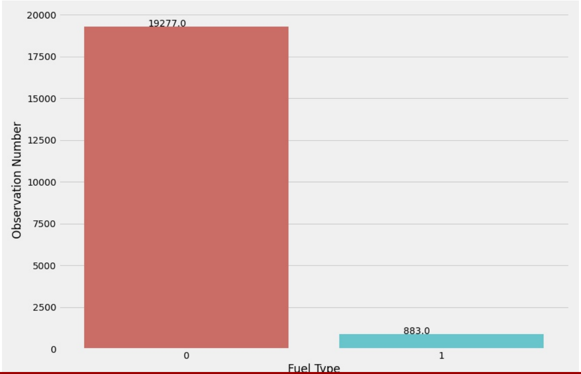
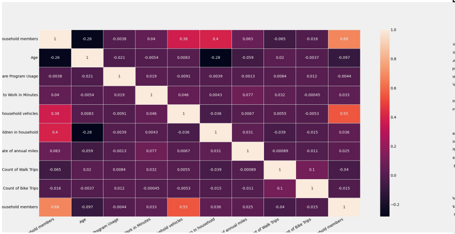
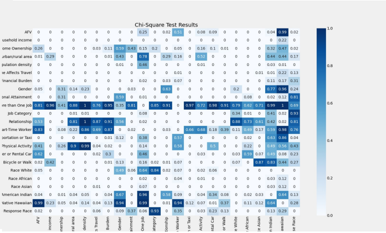


Correlation Analysis

Pearson Correlation



Chi-Square Test



Variance Inflation Factor

	Feature	VIF
0	Household income	19.60
15	Count of household vehicles	8.01
2	Count of household members	13.78
22	Count of adult household members	22.23
4	population density	10.41
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3 Methodology

4 Results

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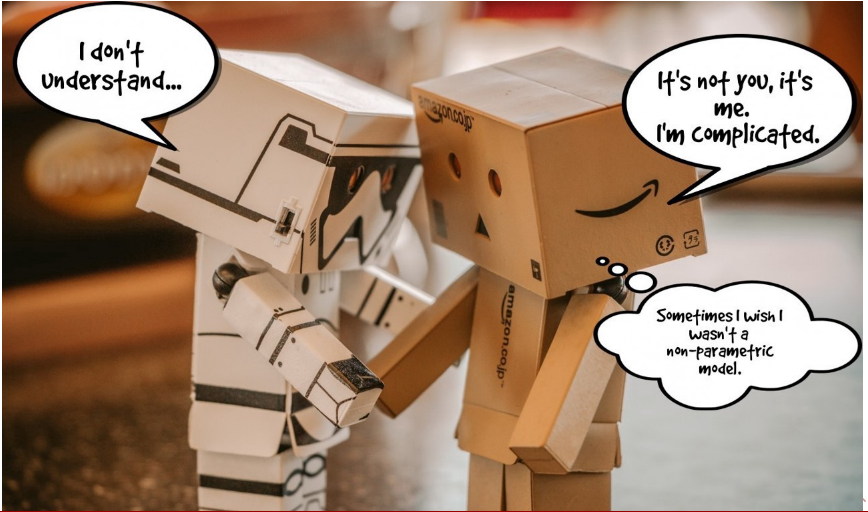
Machine Learning Models

Comparison Between Parametric non-Parametric ML models



Machine Learning Models

Parametric Models

- Logistic Regression.
- LR with FAMD.
- Ridge Regression.
- Lasso Regression.
- Logistic GAM (Semi-Parametric).

Non-Parametric Models

- Naive Bayes.
- K Nearest Neighbors.
- Neural Network.
- Support Vector Machine.
- Random Forest.

Process

- Predict the models using the original DATA.
- Create Artificial Observations (SMOTE NC) on training set only.
- Predict the models after SMOTE NC.
- Add polynomial features to linear models to test their impact on performance.
- Compare between model's performance .

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2. Data
3. Methodology
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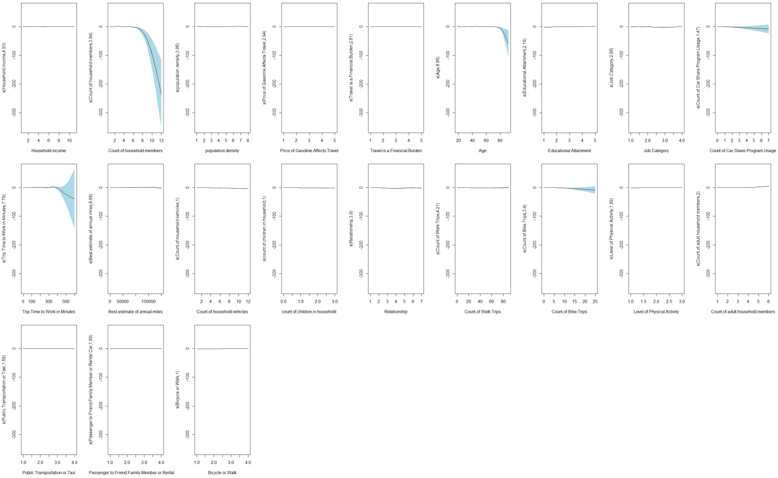
Before SMOTE NC

Classifiers	Accuracy	Recal	F1	Precision	AUC
Logistic regression	0.96	0.00	0.00	0.00	0.50
Lasso regression	0.96	0.00	0.00	0.00	0.50
Ridge regression	0.96	0.00	0.00	0.00	0.50
Naive Bayes	0.95	0.00	0.00	0.00	0.50
KNN	0.92	0.07	0.06	0.06	0.51
Neural Network	0.05	1.00	0.08	0.04	0.51
SVM	0.96	0.00	0.00	0.00	0.50
Random Forest	0.96	0.00	0.00	0.00	0.50

After SMOTE NC

Classifiers	Accuracy	Recal	F1	Precision	AUC
Logistic	0.73	0.47	0.13	0.07	0.60
Polynomial Logistic	0.96	0.00	0.00	0.00	0.50
Logistic with FAMD	0.53	0.67	0.11	0.06	0.60
Lasso	0.72	0.45	0.12	0.07	0.59
Polynomial Lasso	0.78	0.36	0.12	0.07	0.58
Ridge	0.72	0.45	0.12	0.07	0.59
Polynomial Ridge	0.79	0.37	0.13	0.08	0.59
Logistic GAM	0.67	0.54	0.12	0.07	0.61
Naive Bayes	0.52	0.68	0.11	0.06	0.60
KNN	0.74	0.29	0.09	0.05	0.52
Neural Network	0.06	0.97	0.08	0.04	0.49
SVM	0.29	0.71	0.08	0.04	0.49
Random Forest	0.90	0.12	0.09	0.07	0.53

Logistic GAM Plots



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3 Methodology

4 Results

5 Conclusion

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- Linear models outperformed non-parametric models.
- Polynomial features didn't help increasing model's performance.
- No strong non-linear relationship between target variable and features.

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- Features about AFV industry can also impact the individual's behavior such as battery range, price etc (Literature Review).

Conclusion

- Overall model's performance is low (even after SMOTE NC).
- Household individual's characteristics aren't sufficient to predict the consumer's behavior to adopt an AFV.
- Features about AFV industry can also impact the individual's behavior such as battery range, price etc (Literature Review).
- Suggestion for future work to take into account features from all different aspects mentioned above.

Thank You