

CSCI 4360 Data Science II

Project II

Ayush Kumar, Brandon Amirouche, Faisal Hossain

March 30, 2021

Contents

1	AutoMPG	2
1.1	Results	2
1.2	Variable Selection	2

1 AutoMPG

The Goal of the AutoMPG Dataset is to predict the Miles per Gallon that a car will have based on a few key characteristics.

1. cylinders
2. displacement
3. horsepower
4. weight
5. acceleration
6. model-year

1.1 Results

We want to find out if using feed-forward neural networks will offer some sort of advantage over traditional regression modeling. The AutoMPG Dataset only has a few observations so it is highly unlikely that we will be able to fully leverage the power of neural networks because our dataset isn't large enough to have such complicated patterns hidden in it. In addition to this, neural networks are computationally expensive and require much more hyper parameter tuning than a traditional or transformed regression model. The following table summarizes the results of our findings in terms of R^2 , \bar{R}^2 , R_{cv}^2 and AIC for some traditional regression models, and some neural networks.

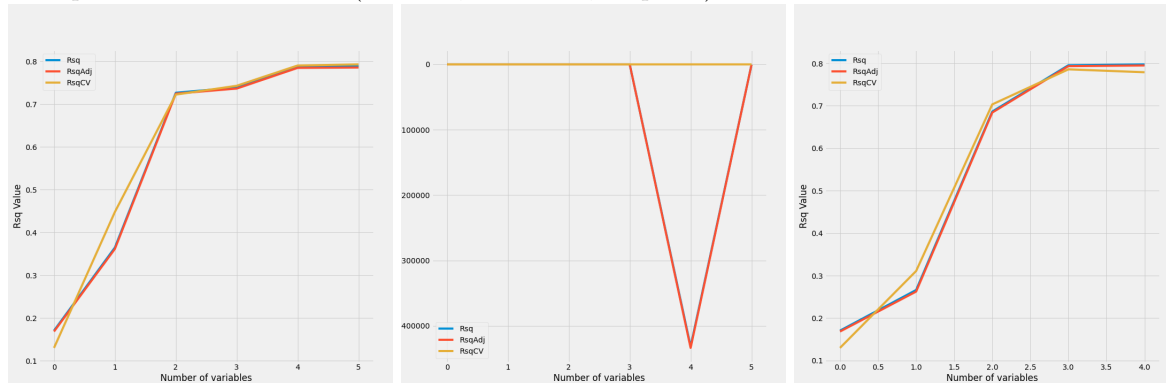
	R^2	\bar{R}^2
Multiple Linear Regression	0.807	0.806
Quadratic Regression	0.876	0.873
Quadratic Regression with Cross Terms	0.883	0.873
Transformed Regression	0.851	0.848
Perceptron	0.734	0.704
3 Layer Neural Network	0.793	0.790
4 Layer Neural Network	0.778	0.776

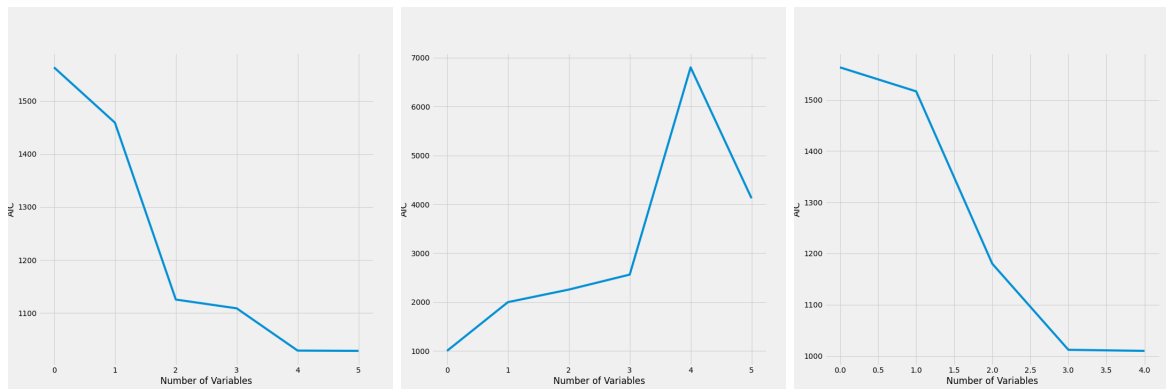
As the directly comparable results show (some results were not stable between python and scala) we can see that the neural network models offer little to no benefit in comparison to the traditional regression models. In fact while the 3 and 4 layer networks perform quite well, they still lag behind a simple quadratic regression, and oftentimes are not stable over repeated training loops. The 4-Layer network is especially prone to breaking, but this may be because of the small size of the dataset in comparison to the number of parameters.

1.2 Variable Selection

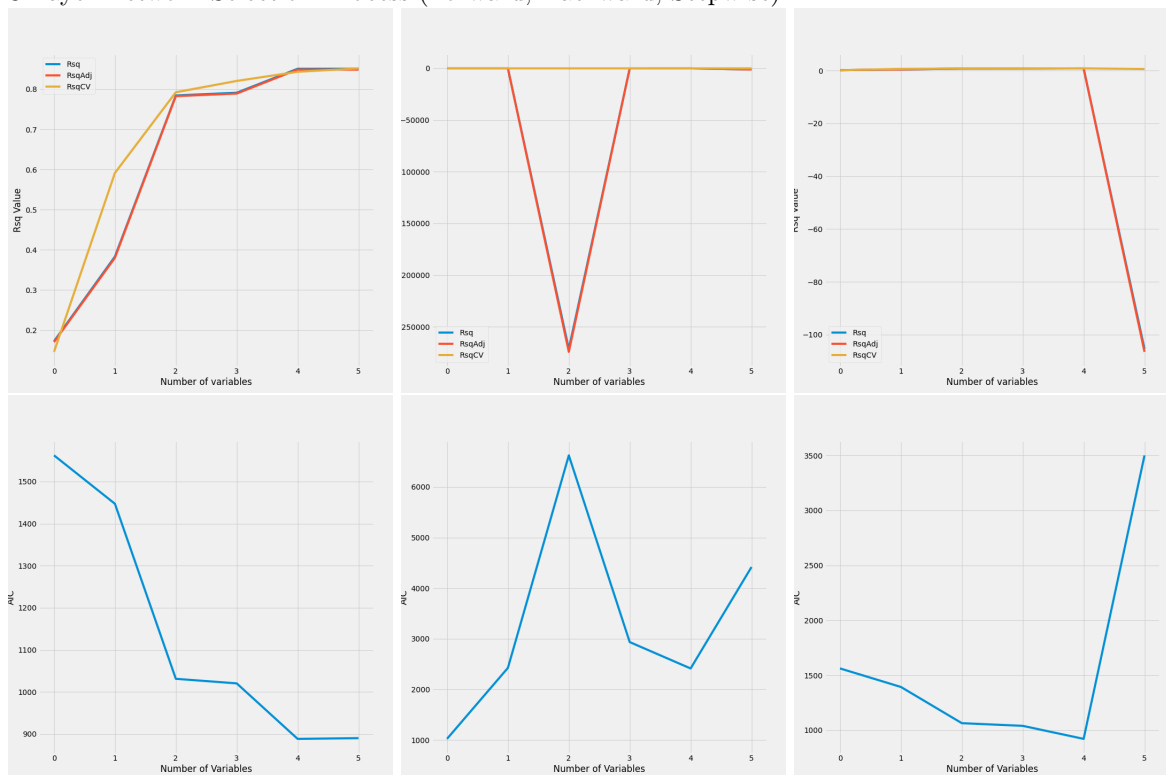
Forward Selection, Backward Elimination, and Stepwise Regression for the 4 models. Some turned out to be not be very stable because of the randomness associated with neural networks. Nonetheless we have some results in the following graphs.

Perceptron Selection Process (Forward, Backward, Stepwise)

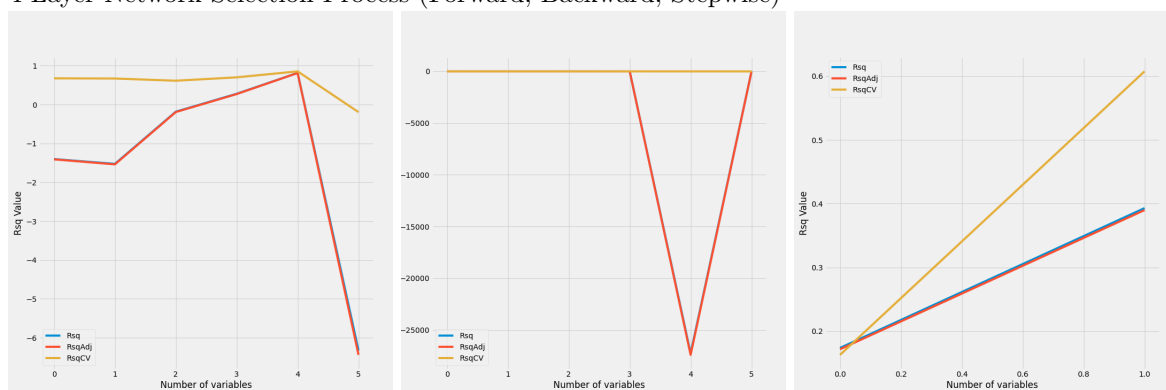


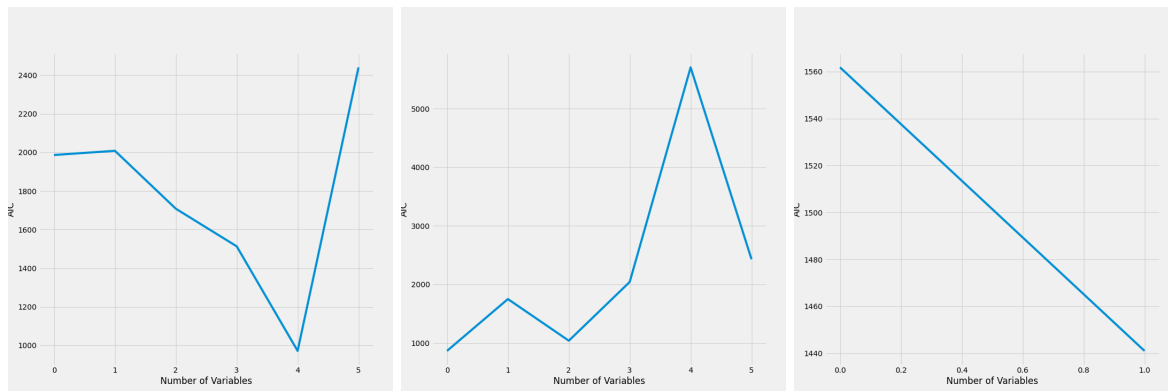


3 Layer Network Selection Process (Forward, Backward, Stepwise)



4 Layer Network Selection Process (Forward, Backward, Stepwise)





As can be seen here is some very peculiar behavior with the model occasionally failing to converge.