

## B565 HW6

1. (b) The coefficient of the “year” attribute is the following: 0.5698716404255911.

What this coefficient says is that there is a strong relationship between the year and the mpg of the vehicle. Therefore, it's an important variable for this problem and should not be removed. This also means that after applying LASSO, the “year” attribute will definitely still be there.

Additionally, it was found that the model had a mean square error value of  $1.8746510415302598e-06$  on the test data set.

(c)

```
coefficients of Ridge: [[ 0.02053449 -0.01912991 -0.03005851 -0.04396165  0.10153373  0.54081557
 0.03769747]]
coefficients of Lasso: [ 0.          0.00883293 -0.04832203 -0.          0.          0.64119412
 0.          ]
```

If we compare the coefficients of the two models Ridge and Lasso, we see the 1st, 4th, 5th, and 7th coefficients in Lasso have been removed, which are cylinder, weight, acceleration, and origin respectively. Additionally, there is even a difference in the magnitudes of the coefficients in 2nd, 3rd and 6th regressors, which are displacement, horsepower, and model year respectively. Generally, we should choose between Ridge and Lasso based on our use case. If it's best to drop variables that are not required, then Lasso would be the better choice. If not, we can go with Ridge also.

(d)

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coefficients of Ordinary Linear Regression: [[ 0.84020765 -0.11601289 -0.1712066  -1.61009463 -0.27982384  0.56987164
 0.84684289]]
coefficients of Ridge: [[ 0.02053449 -0.01912991 -0.03005851 -0.04396165  0.10153373  0.54081557
 0.03769747]]
coefficients of Lasso: [ 0.          0.00883293 -0.04832203 -0.          0.          0.64119412
 0.          ]
```

It seems like there are lots of differences here. Without a regularization method, the weights are pretty large. Otherwise, they are smaller. This could mean that the variance of the ordinary linear regression is low. In other words, it's overfitting. Therefore, the need for punishing the weights.

One interesting observation that can be made is the 6th regressor's weight is similar in all the models. This could mean that changing it a lot isn't improving our results. Otherwise, we see a lot of differences in the magnitudes of the remaining regressors. Especially Lasso has more distinct changes. Mainly because of the 1st, 4th, 5th, and 7th being set to 0. But the remaining attributes are quite similar and only vary a little. So regularization does affect the importance of attributes and does have a significant change. At the end of the day, it's always good to use regularization as a means to prevent overfitting on the training set. However, the type of regularization should be decided based on the kind of problem we are working with and what the use case will be.

**For questions 2/3 please refer to the “HW6 Q2.ipynb” / “HW6 Q3.ipynb” files**