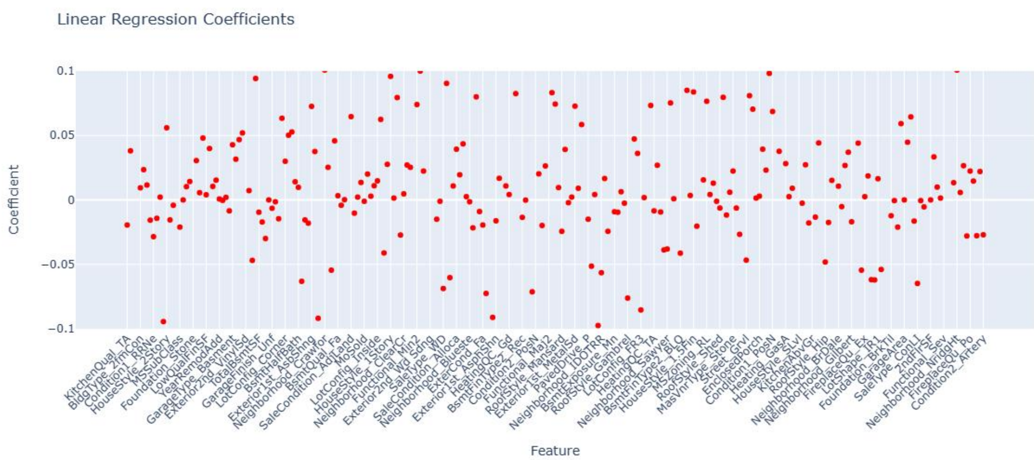
1. Abstracts

The updated project aims to regularize the model and compares the performances among OLS, Lasso and Elastic Net. Then it selects the optimal model based on the MSE (Mean Square Error) and the risk of overfitting.

2. OLS Regression

Firstly, using the dataset handled by preprocessing method mentioned in last assignment, it is easy to generalize the OLS result and coefficients distribution.



Plot 1: OLS Coefficients Distribution

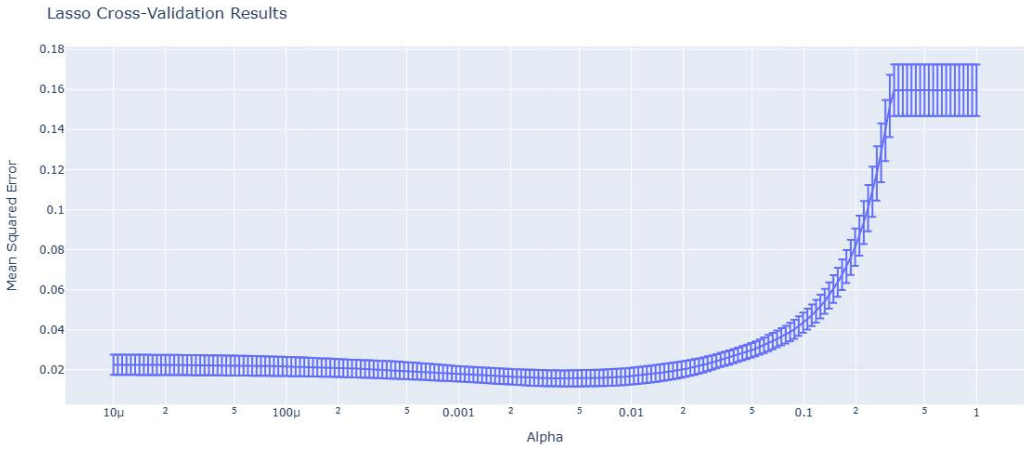
3. Data Scaling

Why choose to standardize data? Because in regularization, the normalized data can help control the penalty term, making the feature selection more stable and accurate.

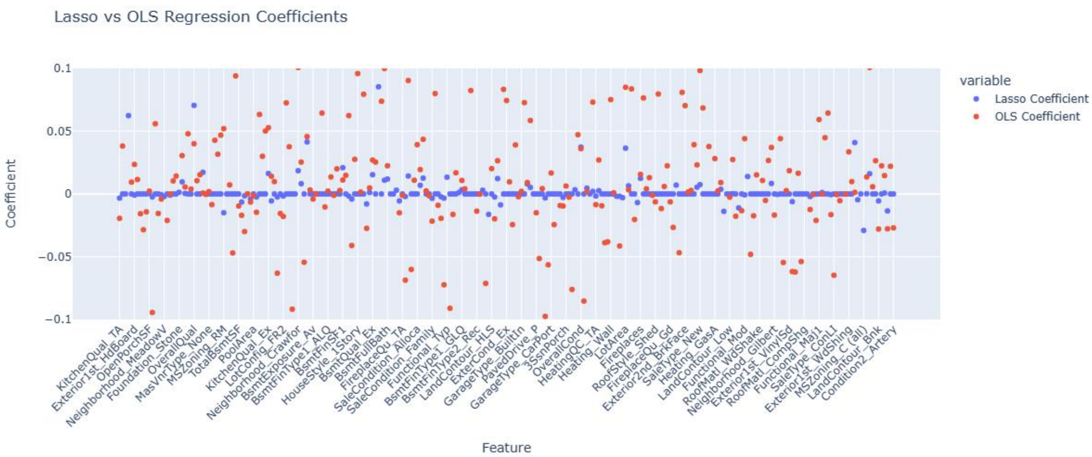
4. Applying Lasso

After scaling, we perform a 5-fold cross-validation to select the alpha value with the best performance as the optimal hyperparameter based on the model's mean square error on each alpha value.

To visualize the effect of Lasso, we make the graph about the coefficients between these models. It is clearly to see that the Lasso model penalizes large coefficients to small and even to zero and make the model more interpretable.



Plot 2: Lasso Cross-Validation Results

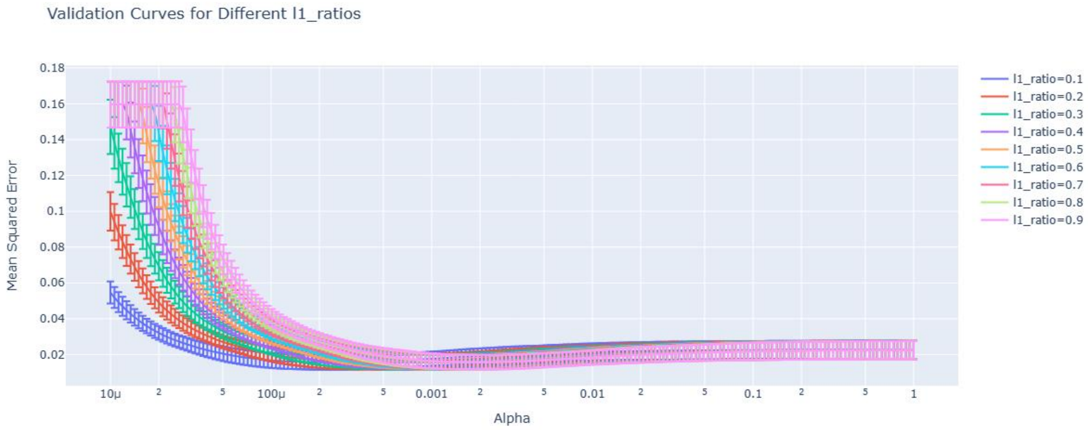


Plot 3: OLS and Lasso Coefficients Distribution

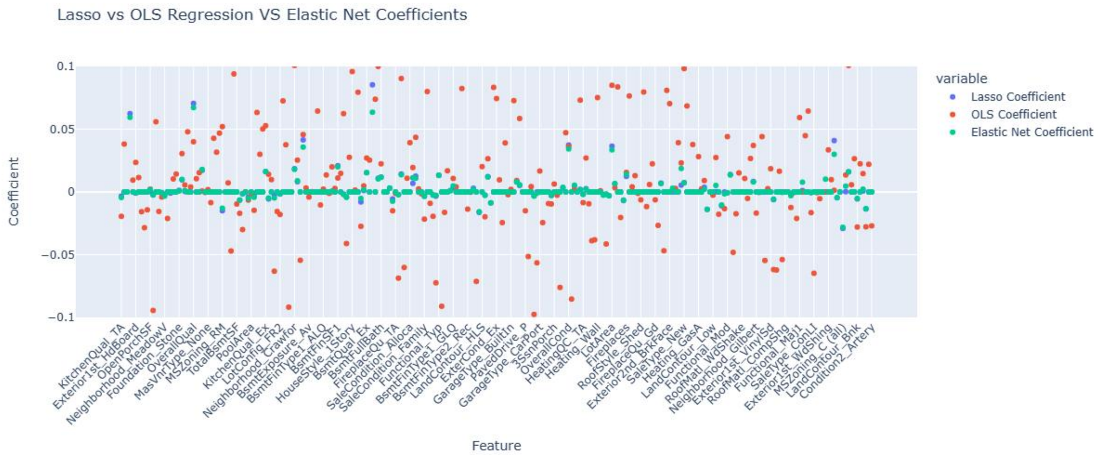
5. Applying Elastic Net

Furthermore, to deal with the problem about multicollinearity, we also employ the Elastic Net model and select the optimal regularization parameter as alpha and the optimal L1 regularization weight as l1_ratio.

After the parameter selection in Elastic Net, we put all three models in a graph together to watch their coefficients. We can see that the coefficients distribution in the Lasso model tends to be sparse, with a large portion being 0, while the Elastic Net model maintains a balance between feature selection and coefficient stability.



Plot 4: Elastic Net Cross-Validation Results



Plot 5: OLS, Lasso and Elastic Net Coefficients Distribution

6. Model Selection and Prediction

Finally, although OLS has a lower MSE, in order to prevent overfitting and improve prediction performance, we plan to select parameters processed by the Lasso model for a new round of housing price prediction. According to Kaggle's results, it is evident that the new model has better prediction accuracy.

OLS	Lasso	Elastic Net
0.009589	0.011743	0.011811

Table 1: Mean Square Error in OLS, Lasso and Elastic Net

Python Code Link:

https://colab.research.google.com/drive/1S3J6Ufu047ufZLHQCK-46cqmzw1XmuQD?usp=drive_link

Kaggle Score: