Problem Statement - Part II

Question 1

What is the optimal value of alpha for ridge and lasso regression? What will be the changes in the model if you choose double the value of alpha for both ridge and lasso? What will be the most important predictor variables after the change is implemented?

Answer: - ***For more detail, please check python notebook***

Optimal value of alpha for Ridge and Lasso Regression is below:

- **Alpha value for Ridge Regression:** 1
- **Alpha value for Lasso Regression:** 0.0001

Increasing Alpha value of Ridge Regression from 1 to 2

```
****************Data after Ridge Regression Alpha Value = 2************
********
Train R2 score:  0.897037606776905
Test R2 score:  0.8756015874789491
Train RSS score:  1.7479548545580181
Test RSS score:  0.952363033697311
Train MSE score:  0.0017120027958452675
Test MSE score:  0.00216939187630367
Train RMSE score:  0.04137635551671108
Test RMSE score:  0.04657673106073106
****************************************************************
```

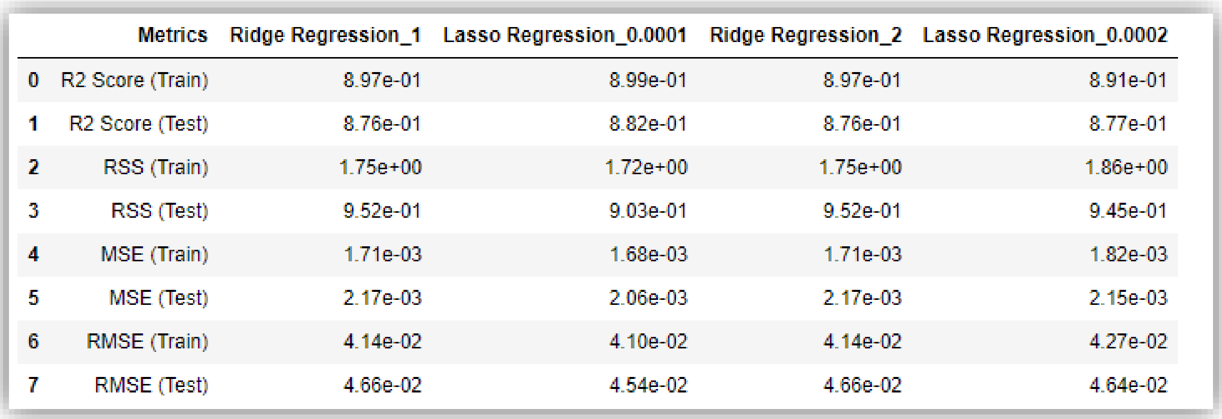
Train R2 score reduces little bit from 90.05% to `89.70`% and Test R2 score also reduce from 87.86% to `87.11`%.

Increasing Alpha value of Lasso Regression from 0.0001 to 0.0002

```
****************Data after Lasso Regression with Value = 0.0002********
************
Train R2 score:  0.8905875740768064
Test R2 score:  0.8765717458583819
Train RSS score:  1.8574546983093807
Test RSS score:  0.9449357445649256
Train MSE score:  0.0018192504390885217
Test MSE score:  0.0021524732222435662
Train RMSE score:  0.042652672121316404
Test RMSE score:  0.04639475425350981
****************************************************************
```

Train R2 score reduces little bit from 89.88% to `89.05`% and Test R2 score also reduce from 88.20% to `87.65`%.

Comparision metric of Ridge and Lasso regression with original and double the value



	Metrics	Ridge Regression_1	Lasso Regression_0.0001	Ridge Regression_2	Lasso Regression_0.0002
0	R2 Score (Train)	8.97e-01	8.99e-01	8.97e-01	8.91e-01
1	R2 Score (Test)	8.76e-01	8.82e-01	8.76e-01	8.77e-01
2	RSS (Train)	1.75e+00	1.72e+00	1.75e+00	1.86e+00
3	RSS (Test)	9.52e-01	9.03e-01	9.52e-01	9.45e-01
4	MSE (Train)	1.71e-03	1.68e-03	1.71e-03	1.82e-03
5	MSE (Test)	2.17e-03	2.06e-03	2.17e-03	2.15e-03
6	RMSE (Train)	4.14e-02	4.10e-02	4.14e-02	4.27e-02
7	RMSE (Test)	4.66e-02	4.54e-02	4.66e-02	4.64e-02

There is minor reduction in both train and test R2 when we double value of alpha

Below are the TOP 10 variables which are significant in predicting the Sale Price after doubling ALPHA values.

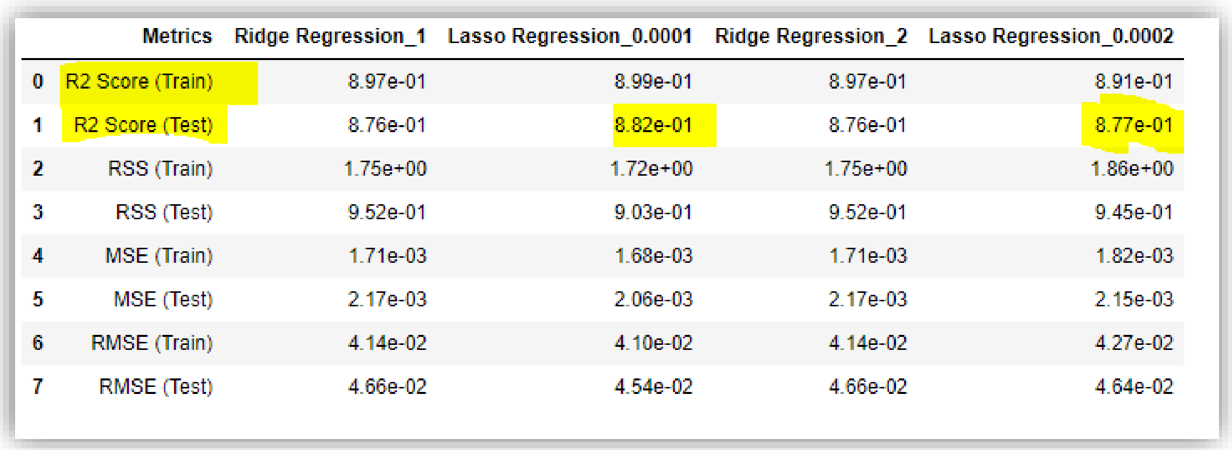
- **GrLivArea:** Above grade (ground) living area square feet.
- **OverallQual:** Rates the overall material and finish of the house.
- **GarageCars:** Size of garage in car capacity.
- **OverallCond:** Rates the overall condition of the house.
- **FullBath:** Full bathrooms above grade
- **BedroomAbvGr:** Bedrooms above grade (does NOT include basement bedrooms)
- **MSZoning_RL:** Identifies residential with Low Density zone.
- **Neighborhood_NridgHt:** hysical locations within Ames city limits Northridge Heights
- **BsmtFullBath:** Basement full bathrooms
- **Neighborhood_Crawfor:** Physical locations within Ames city limits is Crawford.

Question 2

You have determined the optimal value of lambda for ridge and lasso regression during the assignment. Now, which one will you choose to apply and why?

Answer: - *For more detail, please check python notebook*

R2 Score of `Lasso is better than Ridge` for Test Data, so we will prefer to go for Lasso regression.



	Metrics	Ridge Regression_1	Lasso Regression_0.0001	Ridge Regression_2	Lasso Regression_0.0002
0	R2 Score (Train)	8.97e-01	8.99e-01	8.97e-01	8.91e-01
1	R2 Score (Test)	8.76e-01	8.82e-01	8.76e-01	8.77e-01
2	RSS (Train)	1.75e+00	1.72e+00	1.75e+00	1.86e+00
3	RSS (Test)	9.52e-01	9.03e-01	9.52e-01	9.45e-01
4	MSE (Train)	1.71e-03	1.68e-03	1.71e-03	1.82e-03
5	MSE (Test)	2.17e-03	2.06e-03	2.17e-03	2.15e-03
6	RMSE (Train)	4.14e-02	4.10e-02	4.14e-02	4.27e-02
7	RMSE (Test)	4.66e-02	4.54e-02	4.66e-02	4.64e-02

Question 3

After building the model, you realised that the five most important predictor variables in the lasso model are not available in the incoming data. You will now have to create another model excluding the five most important predictor variables. Which are the five most important predictor variables now?

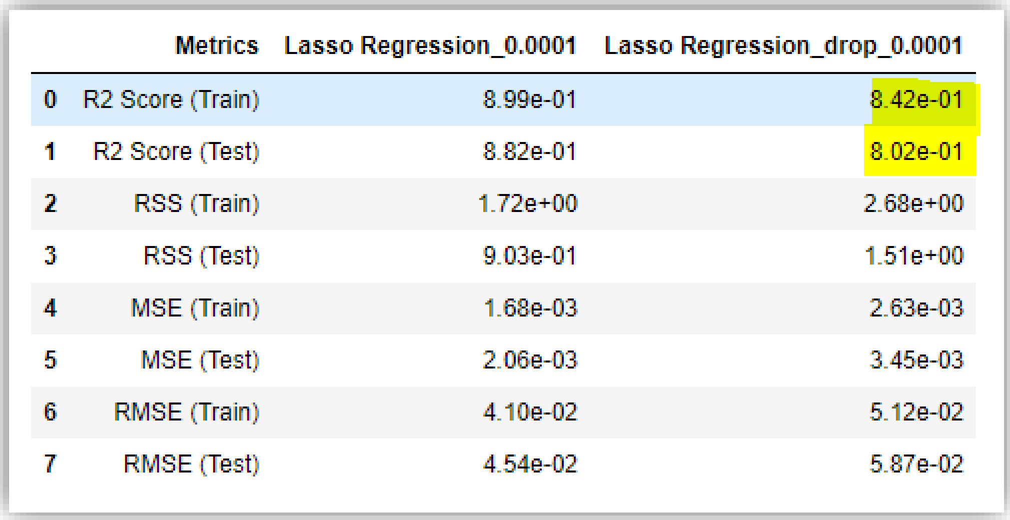
Answer: - *For more detail, please check python notebook*

Below are the TOP 5 variables which are significant in predicting the Sale Price.

- **GrLivArea:** Above grade (ground) living area square feet.
- **OverallQual:** Rates the overall material and finish of the house.
- **GarageCars:** Size of garage in car capacity.
- **OverallCond:** Rates the overall condition of the house.
- **BsmtFullBath:** Basement full bathrooms

```
***************Data after Lasso Regression with Value = 0.0001 after r
emoval top 5 variables******************
Train R2 score:  0.8420975808214957
Test R2 score:  0.802262126816478
Train RSS score:  2.680651561308232
Test RSS score:  1.513831543067687
Train MSE score:  0.0026255157309581115
Test MSE score:  0.0034483634238443896
Train RMSE score:  0.051239786601410736
Test RMSE score:  0.05872276750838971
***************************************************************
```

`Train R2 score reduces` drastically bit from `89.88%` to `84.20%` and `Test R2 score also reduces` from `88.20%` to `80.22%` after removal of Top 5 predictive variables.



	Metrics	Lasso Regression_0.0001	Lasso Regression_drop_0.0001
0	R2 Score (Train)	8.99e-01	8.42e-01
1	R2 Score (Test)	8.82e-01	8.02e-01
2	RSS (Train)	1.72e+00	2.68e+00
3	RSS (Test)	9.03e-01	1.51e+00
4	MSE (Train)	1.68e-03	2.63e-03
5	MSE (Test)	2.06e-03	3.45e-03
6	RMSE (Train)	4.10e-02	5.12e-02
7	RMSE (Test)	4.54e-02	5.87e-02

`Both Train and Test R2 score drastically decreases in Lasso Regression, after we remove top 5 reductive variables`

Below are the TOP 5 variables which are significant in predicting the Sale Price after removing 5 predictive variables from previous model.

- **BedroomAbvGr:** Bedrooms above grade (does NOT include basement bedrooms)
- **LotArea:** Lot size in square feet
- **MSZoning_RL:** Identifies residential with Low Density zone.
- **FullBath:** Full bathrooms above grade
- **BsmtFinSF1:** Type 1 finished square fee

Question 4

How can you make sure that a model is robust and generalisable? What are the implications of the same for the accuracy of the model and why?

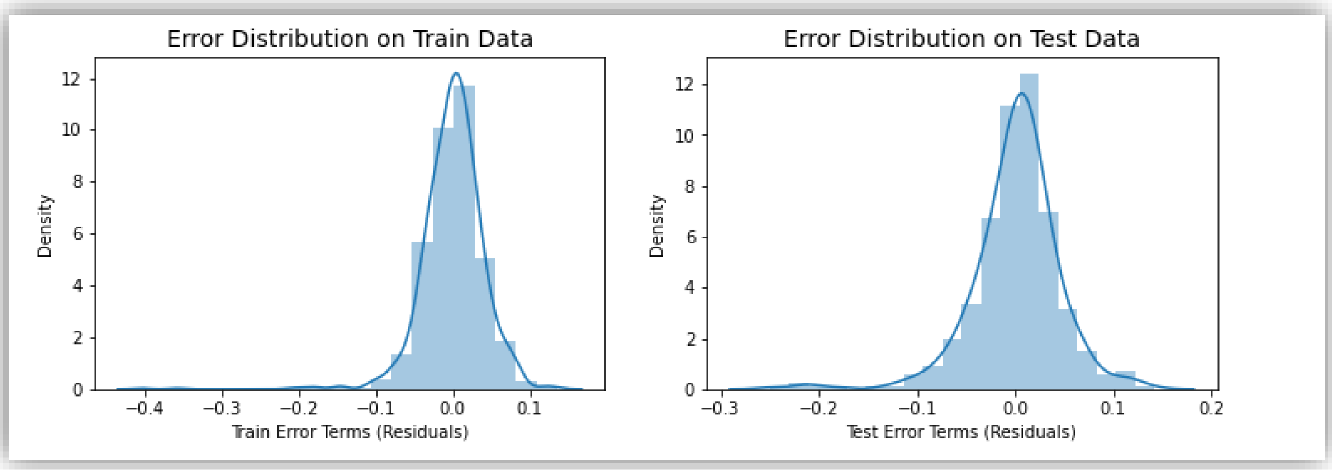
Answer: - ***For more detail, please check python notebook***

Below are the pointers I learn from the course module lecture and note down as key point.

- Robust refers the model works for a broad range of inputs. If the model gets really good results at training time (it seems “more accurate”) but won’t generalize to out-of-sample data (i.e., it isn’t robust) then we call it overfitting.
- The model should be generalized so that the test accuracy is not lesser than the training score.
- Here in our case, based on all data and modelling both Ridge and Lasso performed good on Train and Test Data which shows our model with Alpha value "1" for Ridge and "0.0001" for Lasso is Robust and more Generalized model.
  - Simpler models are more generic
  - Simpler model requires fewer training samples
  - Simpler model is more robust
- Too much importance should not give to the outliers so that the accuracy predicted by the model is high. But outlier’s analysis needs to be done and only those which are relevant to the dataset need to be retained and rest should be dropped.

If the accuracy of the Train and Test are same then that means model is overfitted and it learnt all the Train and Test data and model is not robust and generalized. So, it will drastically be failed and will not work on broad range of unseen data.

Below you can see residual analysis on Train and test data


Error Distribution on Train Data
Density
Train Error Terms (Residuals)
Error Distribution on Test Data
Density
Test Error Terms (Residuals)