Self Case Study on Mercedes-benz greener manufacturing explained

Business problem

Since the first automobile, the Benz Patent Motor Car in 1886, Mercedes-Benz has stood for important automotive innovations. These include, for example, the passenger safety cell with crumple zone, the airbag and intelligent assistance systems. Mercedes-Benz applies for nearly 2000 patents per year, making the brand the European leader among premium car makers. Daimler's Mercedes-Benz cars are leaders in the premium car industry. With a huge selection of features and options, customers can choose the customized Mercedes-Benz of their dreams

To ensure the safety and reliability of each and every unique car configuration before they hit the road, Daimler's engineers have developed a robust testing system. But, optimizing the speed of their testing system for so many possible feature combinations is complex and time-consuming without a powerful algorithmic approach. As one of the world's biggest manufacturers of premium cars, safety and efficiency are paramount on Daimler's production lines

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<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcTADrAryZWM2MQP_Wr1MoX1NEp88qgZJ7nMpSB9hsdpkAD6QXKJ"></img>

<u>What we achieve with this case study</u> : In this Case study we will reduce the time that cars spend on the test bench

Data Given

```
Column      Type      Count
0           int64      369
1           float64     1
2           object       8


1) We have given 4209 rows and 378 features, Above is the type of the coloumn data given to
us.

2) We have given 4209 rows and 377 features, Above is the type of the coloumn data given to
us for test also

3) For kaggle competition R^2 is the score that they want us to optimize.
```

Problem Analysis.

```
1. Regression problem

2. Problem Interpretibility : As we have not been given column name, we can't interpret
this problem based on the                  features we have given. Although , we can say best
column number to get the best result

3. Measurement criterian used : R^2 and RMSE, Kaggle used R^2 to measure private score

4. As we have to predict values of y(dependent variable) in sec, this is regression
problem, i will use different regression models to solve this problem and at last i will tr
y deep learning model to predict y as well
```

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```
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```
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```

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```
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```

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```
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```

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```
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6.2. Kaggle Result : Got under top private score 3.6% iwth R^2 value : 55.241
```

7.Deep Learning Model Architecture

8.Summary of whole Case Study

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Case Study Score : .55241 in private score which is under top 3.5%

<img src = "https://i.imgur.com/E7lrUIE.png" width="800" height="100"></img>

In [158]:

In [158]:

```
import pandas as pd
import numpy as np
from sklearn.base import BaseEstimator,TransformerMixin, ClassifierMixin
from sklearn.preprocessing import LabelEncoder
import xgboost as xgb
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
from sklearn.linear_model import ElasticNetCV, LassoLarsCV
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.pipeline import make_pipeline, make_union
from sklearn.utils import check_array
from sklearn.preprocessing import StandardScaler
from sklearn.tree import DecisionTreeRegressor
from sklearn.random_projection import GaussianRandomProjection
from sklearn.random_projection import SparseRandomProjection
from sklearn.decomposition import PCA, FastICA
from sklearn.decomposition import TruncatedSVD
from sklearn.metrics import r2_score,mean_squared_error
from sklearn.model_selection import train_test_split
from sklearn.model_selection import RandomizedSearchCV
from matplotlib import pyplot as plt
from sklearn.preprocessing import StandardScaler
import seaborn as sns
from sklearn.preprocessing import LabelEncoder,OneHotEncoder
from sklearn.feature_extraction.text import CountVectorizer
from tqdm.notebook import tqdm
from sklearn.ensemble import GradientBoostingRegressor
from scipy.sparse import hstack
from sklearn.model_selection import train_test_split
from sklearn.ensemble import StackingRegressor
from sklearn.linear_model import Ridge,Lasso,ElasticNet,LassoLarsCV
import warnings
from sklearn.svm import SVR
warnings.filterwarnings("ignore")
from sklearn.linear_model import Lasso,LinearRegression
from sklearn.model_selection import cross_validate
# from google.colab import drive
import io,pickle
```

In [159]:

```
train = pd.read_csv("train/train.csv")
test = pd.read_csv("test/test.csv")
```

1.Data Exploration

1.1. Checking for Y values range :

In [5]:

```
dtype_df = train.dtypes.reset_index()
dtype_df.columns = ["Count", "Column Type"]
dtype_df.groupby("Column Type").aggregate('count').reset_index()
```

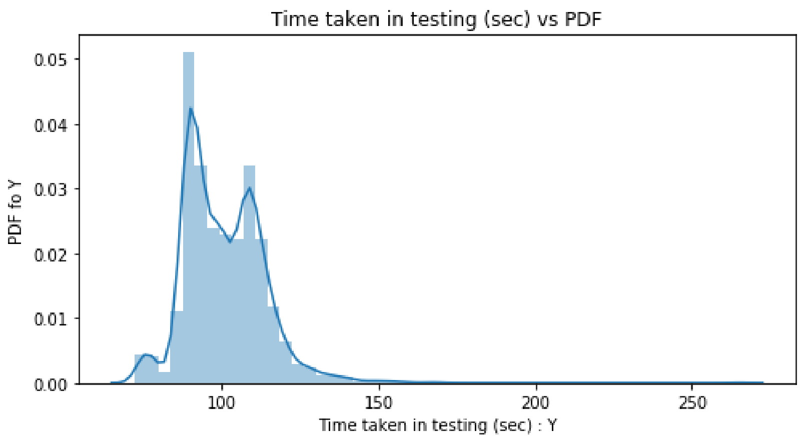
Out[5]:

	Column Type	Count
0	int64	369
1	object	8

In [15]:

```
# Cheking for Y values range :
plt.figure(figsize=(8,4))
plt.title("Time taken in testing (sec) vs PDF")
sns.distplot(train["y"])
plt.xlabel("Time taken in testing (sec) : Y")
plt.ylabel("PDF fo Y")
```

```
plt.show()
```



<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGI2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

<u>My Thought Process</u> : Ohh!! In Dependent variable Y i think there are some outliers (Some right skewness i can see) which can affect my R^2 value when i will use them in my upcoming model, let's check what are those outliers values.Let's see these outlier value closely

In [37]:

```
# Lets check how many points after 150 sec
import numpy as np
def percentile_(start,end,step):
    for i in range(start,end,step):
        print(f"{i}% percentile point :  {np.percentile(train['y'],i)}")
print("#"*18 + "Summary" + "#"*18)
percentile_(0,101,10)
print("#"*40)
percentile_(90,101,1)
print(f"Total points after 150 sec are  : {len([i for i in train['y'] if i > 150])}")
print("#"*40)
# print(f"Points are a follow  : \n{[i for i in train['y'] if i > 150]}")
```

```
##################Summary##################
0% percentile point :  72.11
10% percentile point :  88.07
20% percentile point :  89.96
30% percentile point :  91.91
40% percentile point :  94.84
50% percentile point :  99.15
60% percentile point :  103.77
70% percentile point :  107.766
80% percentile point :  110.594
90% percentile point :  115.25
100% percentile point :  265.32
########################################
90% percentile point :  115.25
91% percentile point :  116.0484
92% percentile point :  116.89160000000001
93% percentile point :  118.0376
94% percentile point :  119.056
95% percentile point :  120.80600000000001
96% percentile point :  122.4
97% percentile point :  125.89319999999998
98% percentile point :  129.2992
99% percentile point :  137.4304
100% percentile point :  265.32
Total points after 150 sec are  : 15
########################################
```

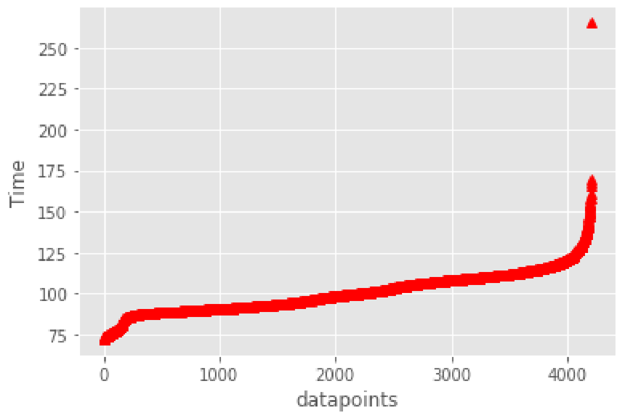
<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGI2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

My Thought Process :Well!! i was right i can see there is large gap between 99 percentile and 100

My Thought Process .Well!! I was right I can see there is large gap between 99 precentile and 100 precentile values i.e. jumping from 137.43 to 265.32 which is larger tha nother differences comparatively Woohh, Let's see that in graph how it looks.......

In [0]:

```
plt.plot(sorted(train['y']),'r^')
plt.xlabel("datapoints")
plt.ylabel("Time")
plt.show()
```



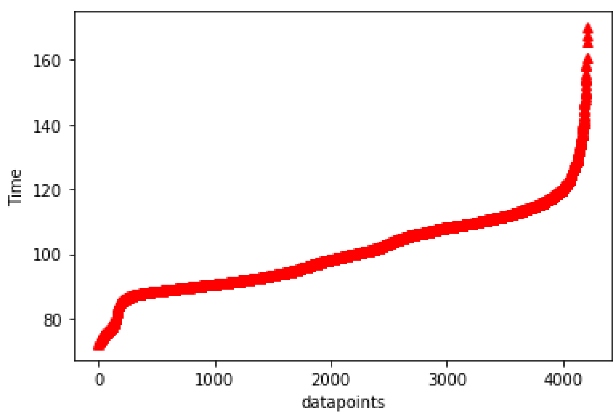
<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

My Thought Process Goccha!! There is that value sitting alone after 250 sec, umm,what should i do now, let's remove this 265.32 with mean of the Y. that will be great idea because that value will fit inside my nice curve above and will not affect my R*2, if it will not give good result i will come back here and see what value should i give here.....

In [33]:

```
clipped_y = []
print("mean value of Y is :", np.mean(train['y']))
[clipped_y.append(np.mean(train['y'])) if i>250 else clipped_y.append(i) for i in train['y']]
train['y'] = clipped_y
plt.plot(sorted(train['y']),'r^')
plt.xlabel("datapoints")
plt.ylabel("Time")
plt.show()
```

```
mean value of Y is : 100.66931812782121
```



<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

My Thought Process

1. After removing 265.32 point, i can see some more oulier, let's see what are those :

```
Points are a follow  :
[150.43, 169.91, 154.87, 265.32, 158.53, 154.43, 160.87, 150.89, 152.32, 167.45, 154.16,
158.23, 153.51, 165.52, 155.62]
```


2. I tried using more than 150 sec as outlier but considering 265.32 as outlier gave me good kaggle score which we will see further why that happened?

3. Moreover, Considering 265.32 as outlier and imputing with 130 gave more heads up in kaggle private score, which is good point why? we will discuss further.

3. Let's continue with treating 150 we treat it as outlier and impute it with mean of train["y] which is 100

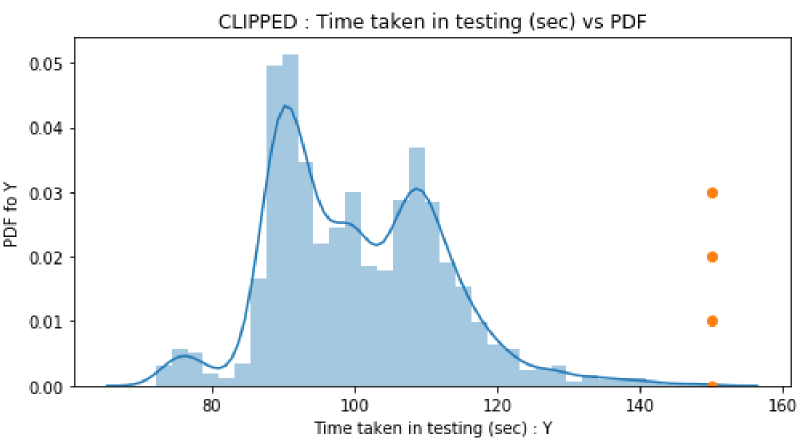
In [38]:

```
print(f"Points are a follow  : \n{[i for i in train['y'] if i > 150]}")
```

```
Points are a follow  :
[150.43, 169.91, 154.87, 265.32, 158.53, 154.43, 160.87, 150.89, 152.32, 167.45, 154.16, 158.23,
153.51, 165.52, 155.62]
```

In [39]:

```
plt.figure(figsize=(8,4))
clipped_y = []
[clipped_y.append(100.66931812782121) if i>150 else clipped_y.append(i) for i in train['y']]
# We will clip Y values after 150 sec so that outliers will not affect our result that much.
plt.title("CLIPPED : Time taken in testing (sec) vs PDF")
sns.distplot(clipped_y)
plt.xlabel("Time taken in testing (sec) : Y")
plt.ylabel("PDF fo Y")
plt.plot([150,150,150,150],[0,.01,.02,.03],'o')
plt.show()
```



In [46]:

```
# Lets check how many points after 150 sec
import numpy as np
def percentile_(start,end,step):
    for i in range(start,end,step):
       print(f"{i}% percentile point :  {np.percentile(clipped_y,i)}")
print("#"*18 + "Summary" + "#"*18)
print(f"Total points after 150 sec are  : {len([i for i in clipped_y if i > 150])}")
print("#"*40)
print(f"Points are a follow  : \n{[i for i in clipped_y if i > 150]}")
```

```
##################Summary##################
Total points after 150 sec are  : 0
########################################
Points are a follow  :
```

```
[]
```

1.2. Checking for catagorical features Features :

We have 8 catagorical : ['X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8'] , remaining all binary

1.2.1. Bar graphs

In [0]:

```
dtype_df = train.dtypes.reset_index()
dtype_df.columns = ["Count", "Column Type"]
dtype_df.groupby("Column Type").aggregate('count').reset_index()
```

Out[0]:

	Column Type	Count
0	int64	369
1	float64	1
2	object	8

In [0]:

```
for key,value  in train.columns.to_series().groupby(train.dtypes).groups.items():
    if key == 'O':
        print("Catagorical features : ",value)
```

```
Catagorical features :  Index(['X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8'], dtype='object')
```

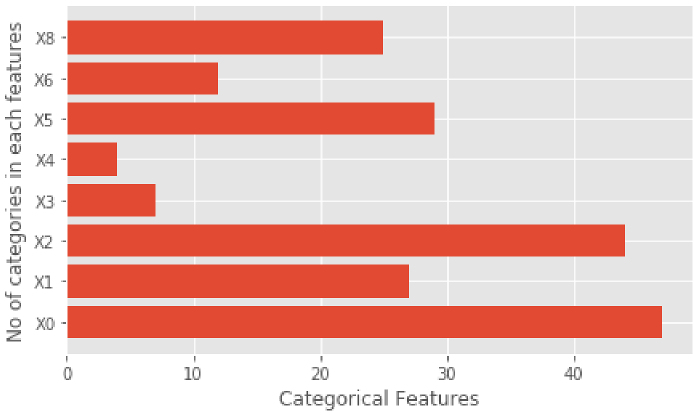
In [0]:

```
Categorcial_dict = {}
for i in ['X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8']:
    Categorcial_dict.update({i : len(train[i].value_counts())})
```

In [0]:

```
# plt.style.available
plt.figure(figsize=(8,4))
plt.style.use('ggplot')
fig, ax = plt.subplots(figsize=(7,4))
plt.barh(list(Categorcial_dict.keys()) , list(Categorcial_dict.values()), animated = 1)
# df.plot(kind='barh', legend = False, ax=ax)
ax.set_xlabel('Categorical Features')
ax.set_ylabel('No of categories in each features')
plt.show()
print(f"Total catagories in train data : {sum(Categorcial_dict.values())}")
```

```
<Figure size 576x288 with 0 Axes>
```



```
Total catagories in train data : 195
```

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

<u>My Thought Process</u>

1. **We have 8 catagorical features, 1 numerical, remaining 369 features are binnary features**

2. **While looking catagorical features number of catagory we can see that X0 and X2 are the featu res whith more than 40 catagory so these features might be some features of the car with som n ay variants in it. Might be possible!! not sure**

3. **While looking catagorical features number of catagory we can see that X0 and X2 are the featu res whith more than 40 catagory so these features might be some features of the car with som n ay variants in it. Might be possible!! not sure**

4. **X4 is the features with least number of catagories in it**

****

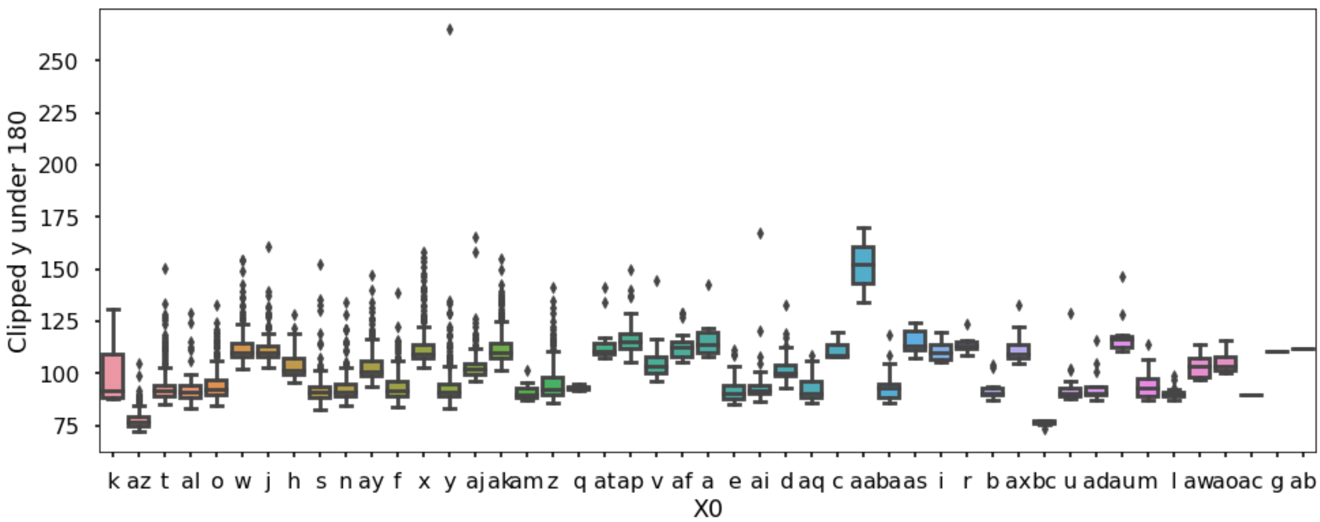
1.2.2. Violin plot for catagorical features

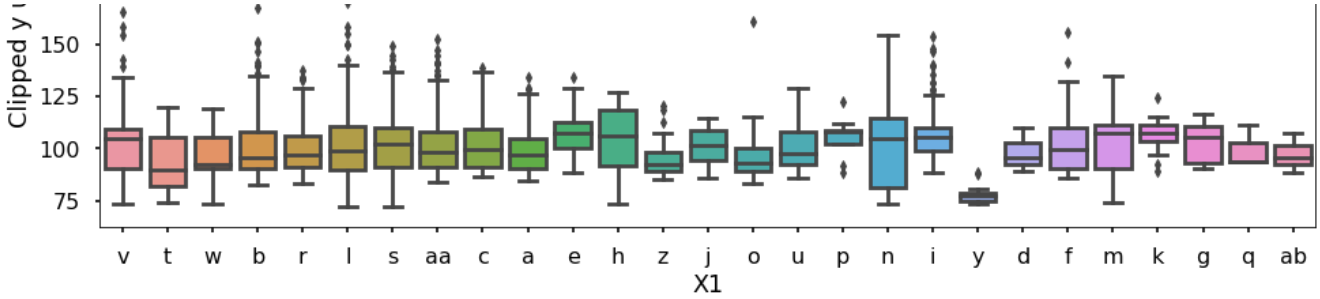
In [47]:

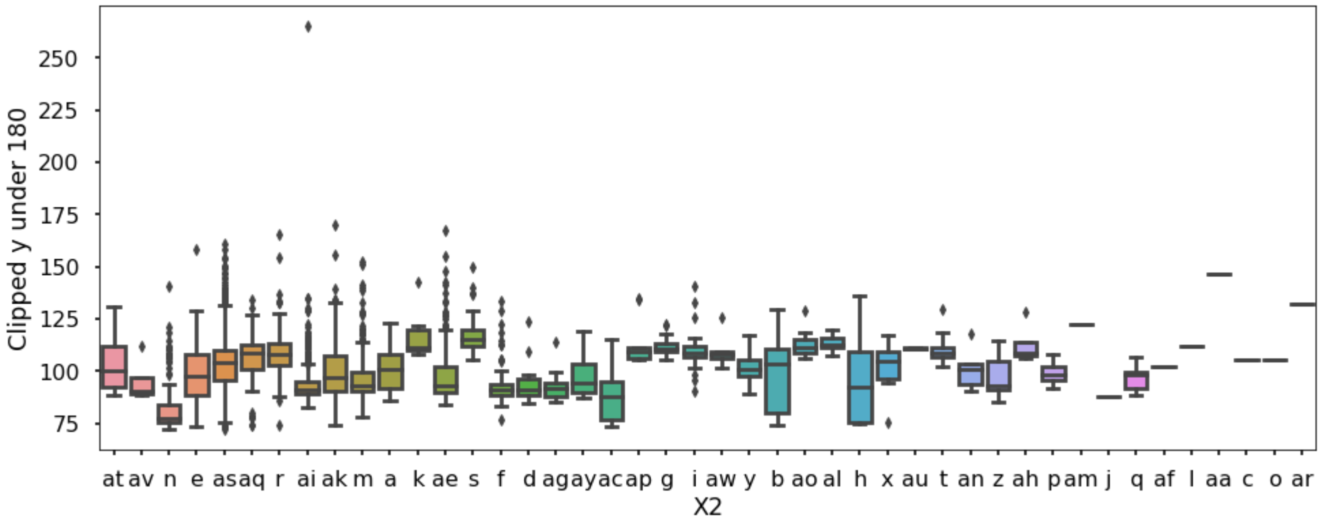
```
# This function create boxplot.
def Boxplot(feature_name):
    plt.style.use('seaborn-poster')
    plt.figure(figsize=(16,6))
    sns.boxplot(y='y', x=feature_name, data=train[['X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8','
y']])
    plt.ylabel("Clipped y under 180")
    return plt
```

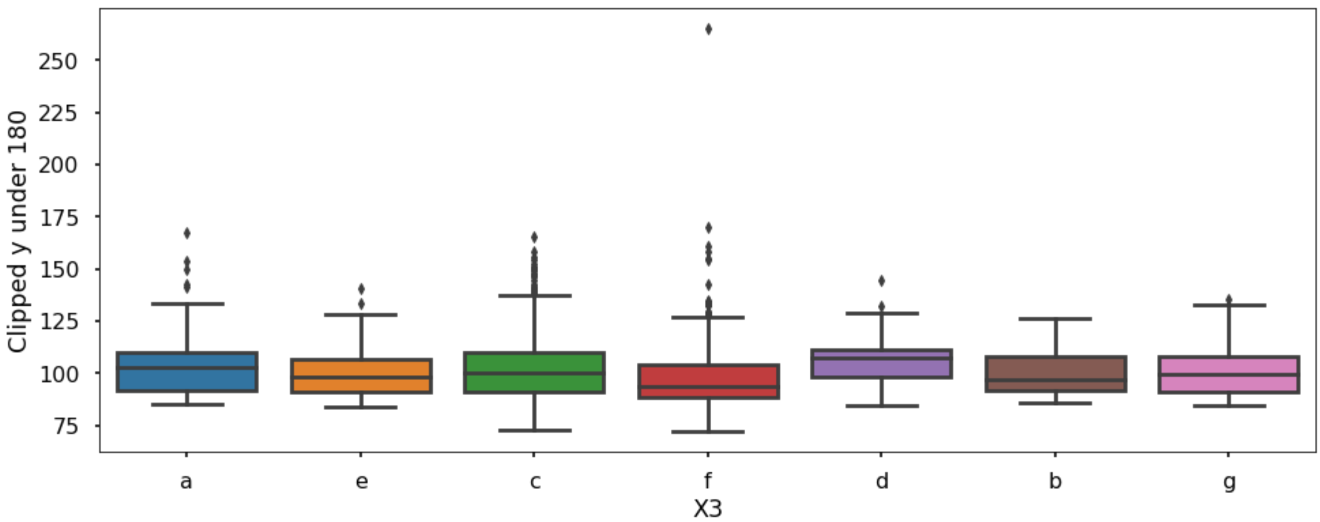
In [0]:

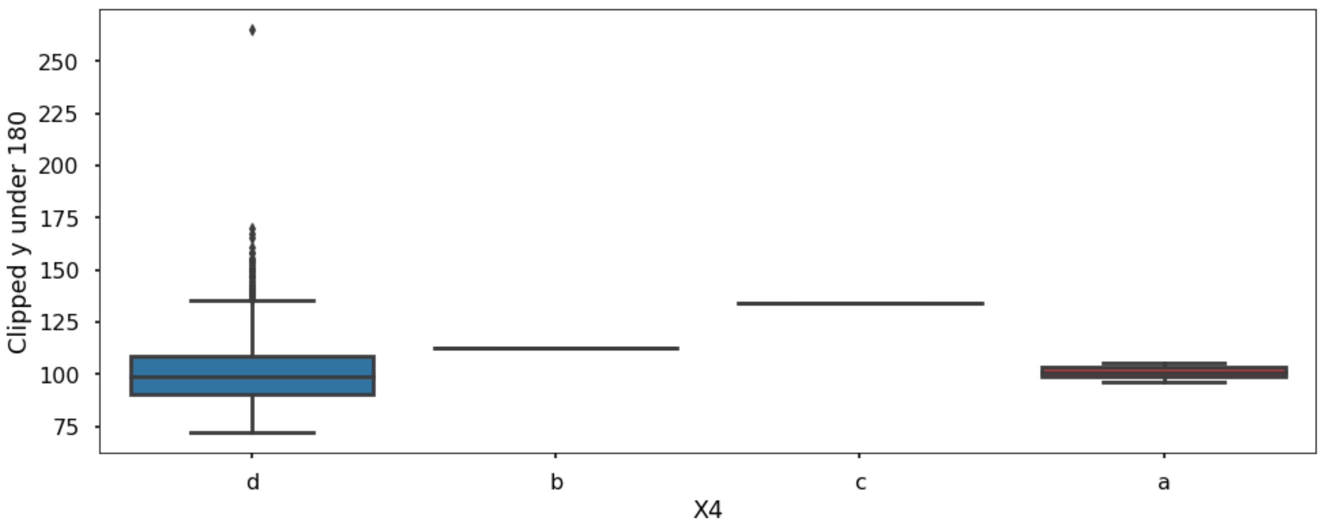
```
for i in ['X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8']:
    plot =  Boxplot(i)
    plot.show()
```

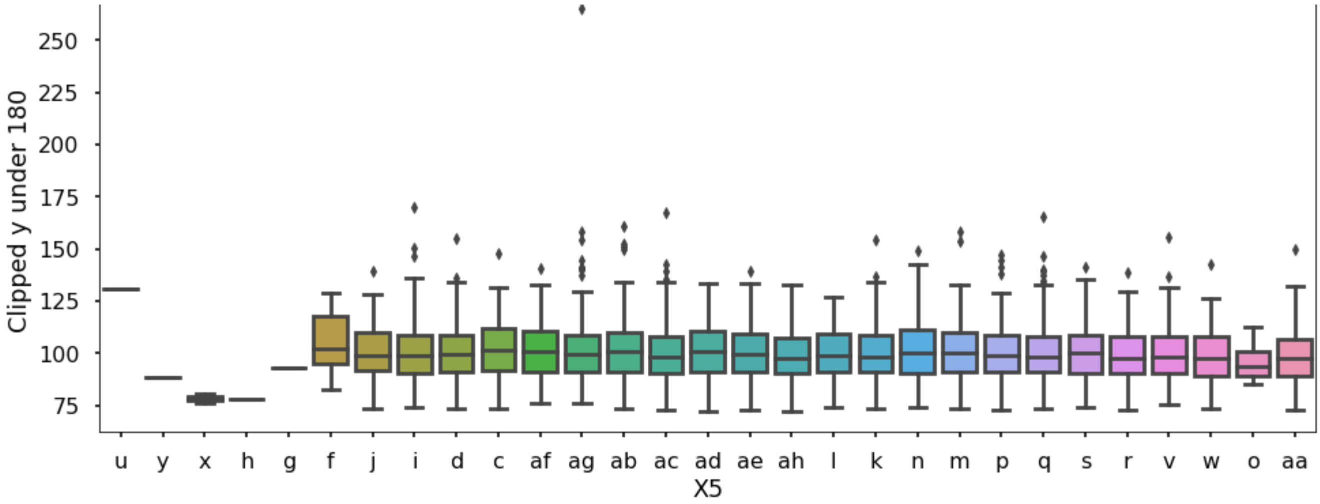


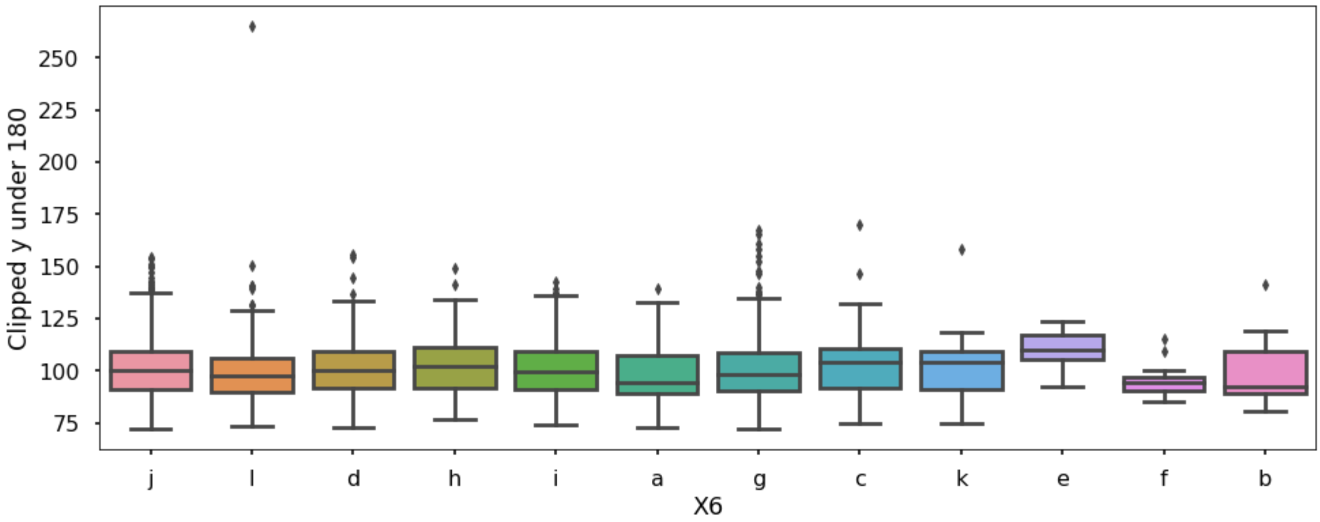

Clipped y
150
125
100
75
v t w b r l s aa c a e h z j o u p n i y d f m k g q ab
X1

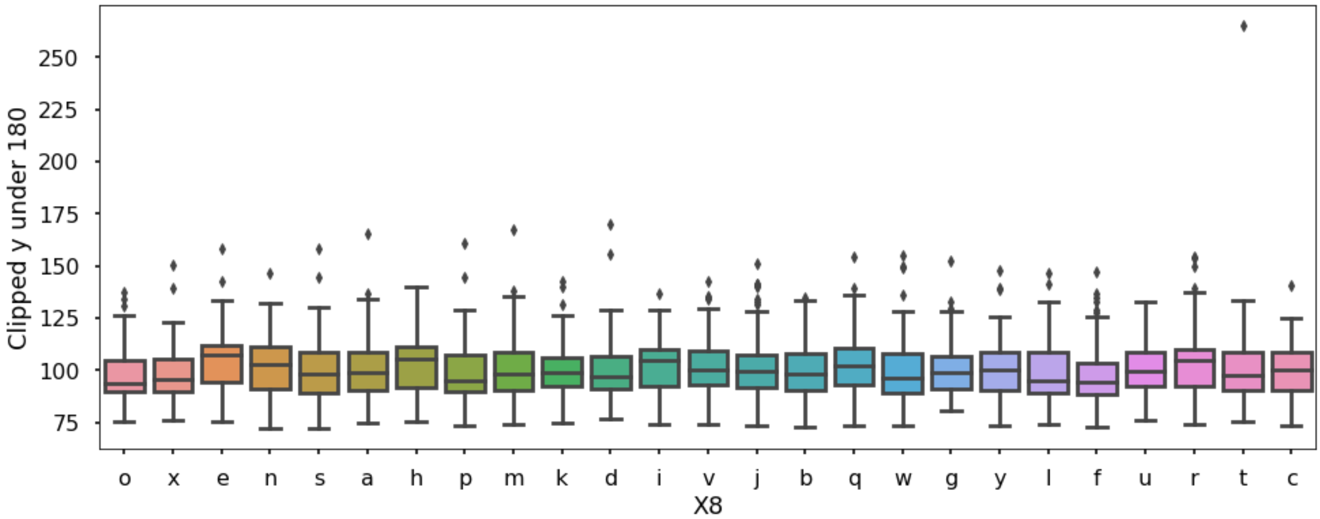

Clipped y under 180
250
225
200
175
150
125
100
75
at av n e as aq r ai ak m a k ae s f d ag ay ac ap g i aw y b ao al h x au t an z ah p am j q af l aa c o ar
X2


Clipped y under 180
250
225
200
175
150
125
100
75
a e c f d b g
X3


Clipped y under 180
250
225
200
175
150
125
100
75
d b c a
X4







<u>Summary</u> : Observations from above catagorical plots

0. Above box plot show each catagory of feature's quantile range w.r.t (Y) </br>

1. X0 and X2 contain more than 40 catagories </br>

2. X0, X2, X5 contain more number of outliers </br>

3. X3 conatinas less noise but not well seprated box plots

3. X5 contatinas less noise but not well seprated box plots
</br>

4. X3, X4 contains less than 8 catagories
</br>

5. In X4 most of the datapoints is of "d" catagory
</br>

6. From above we can't say that which is very good in prediciting Y value, By seeing thing i get the idea to use either forward featiure selection or correlation factor with Y(Pearson correlation)
</br>

1.3. Plot for Binnary features

In [0]:

```
catagorical_features = ['X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8','y','ID']
binnary_features = [i for i in train.columns.tolist() if i not in catagorical_features]
```

In [0]:

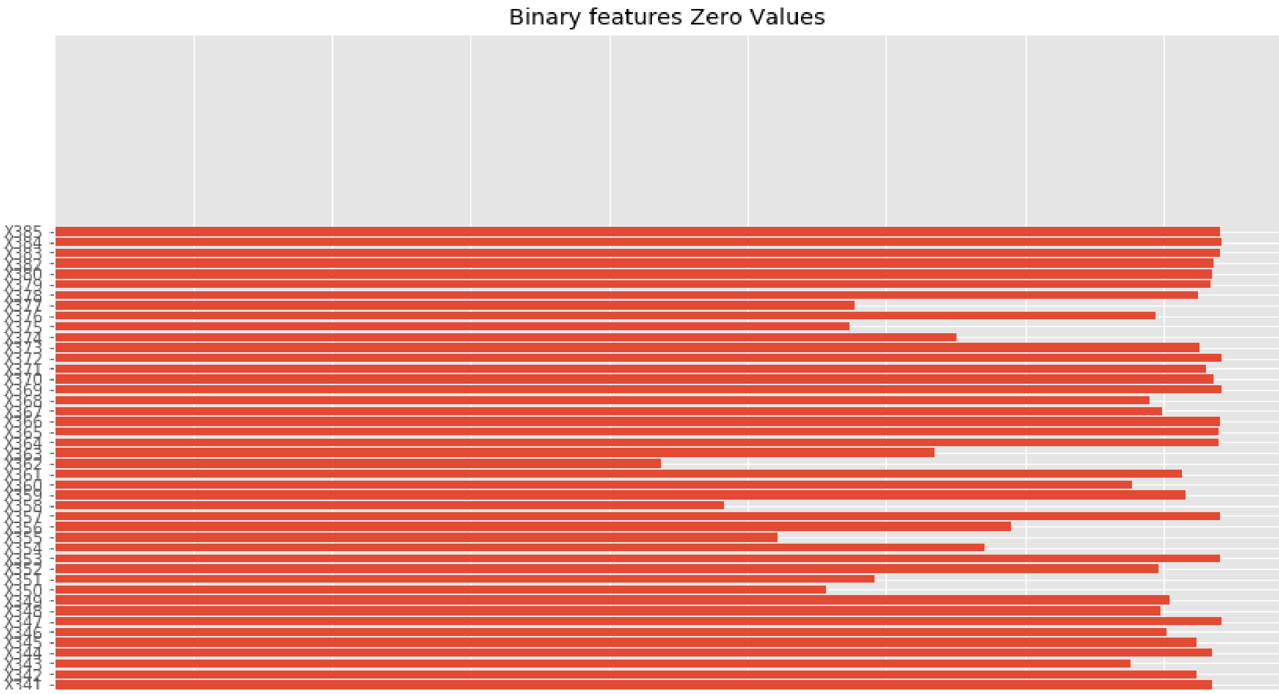
```
bar_dict_0 = dict()
bar_dict_1 = dict()
for i in binnary_features:
    bar_dict_0.update({i : list(train[i].value_counts().reset_index().iloc[0])[1] })

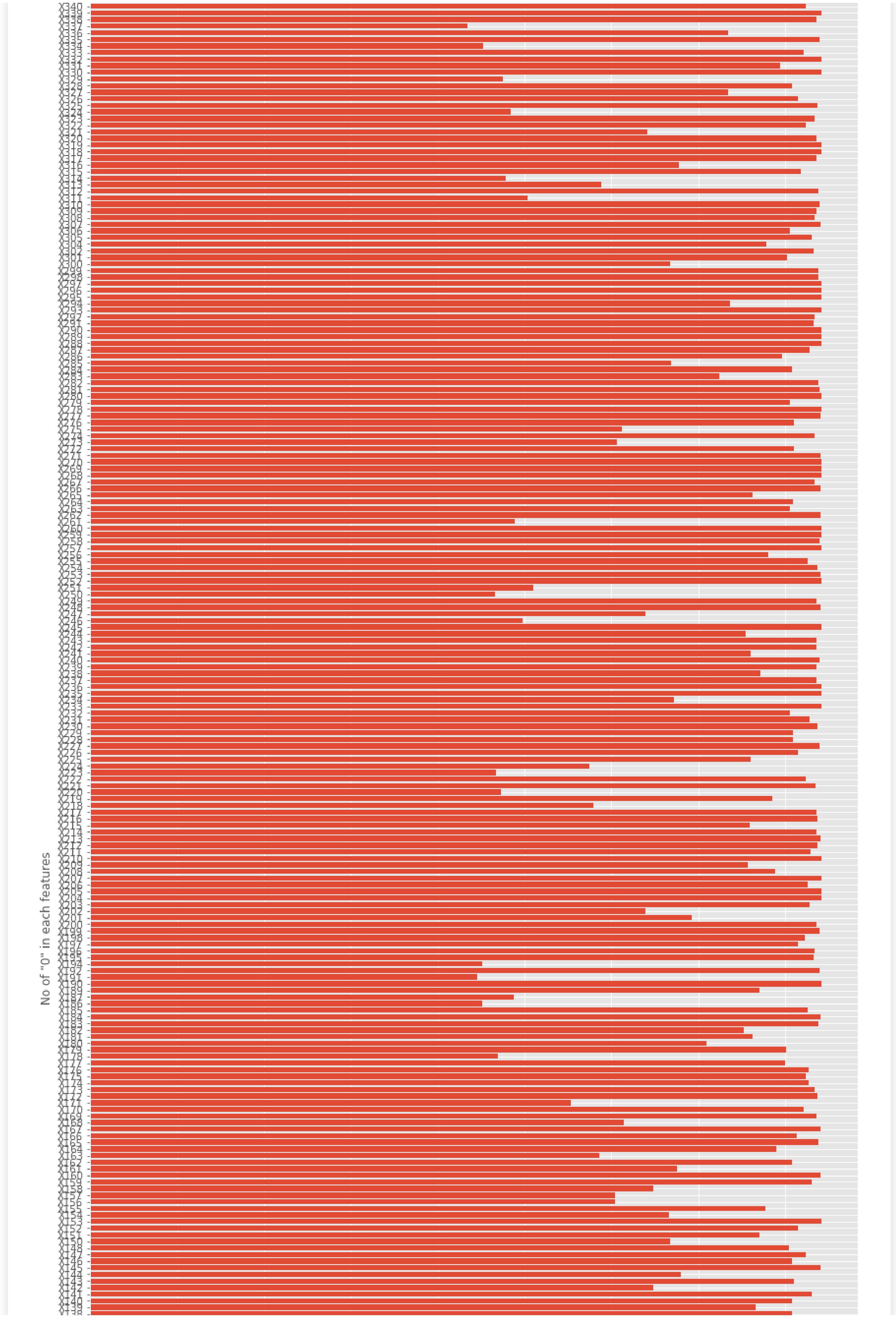
for i in binnary_features:
    if (len(list(train[i].value_counts())) == 1):
        bar_dict_1.update({i : 0})
    else:
        bar_dict_1.update({i : list(train[i].value_counts().reset_index().iloc[1])[1] })
```

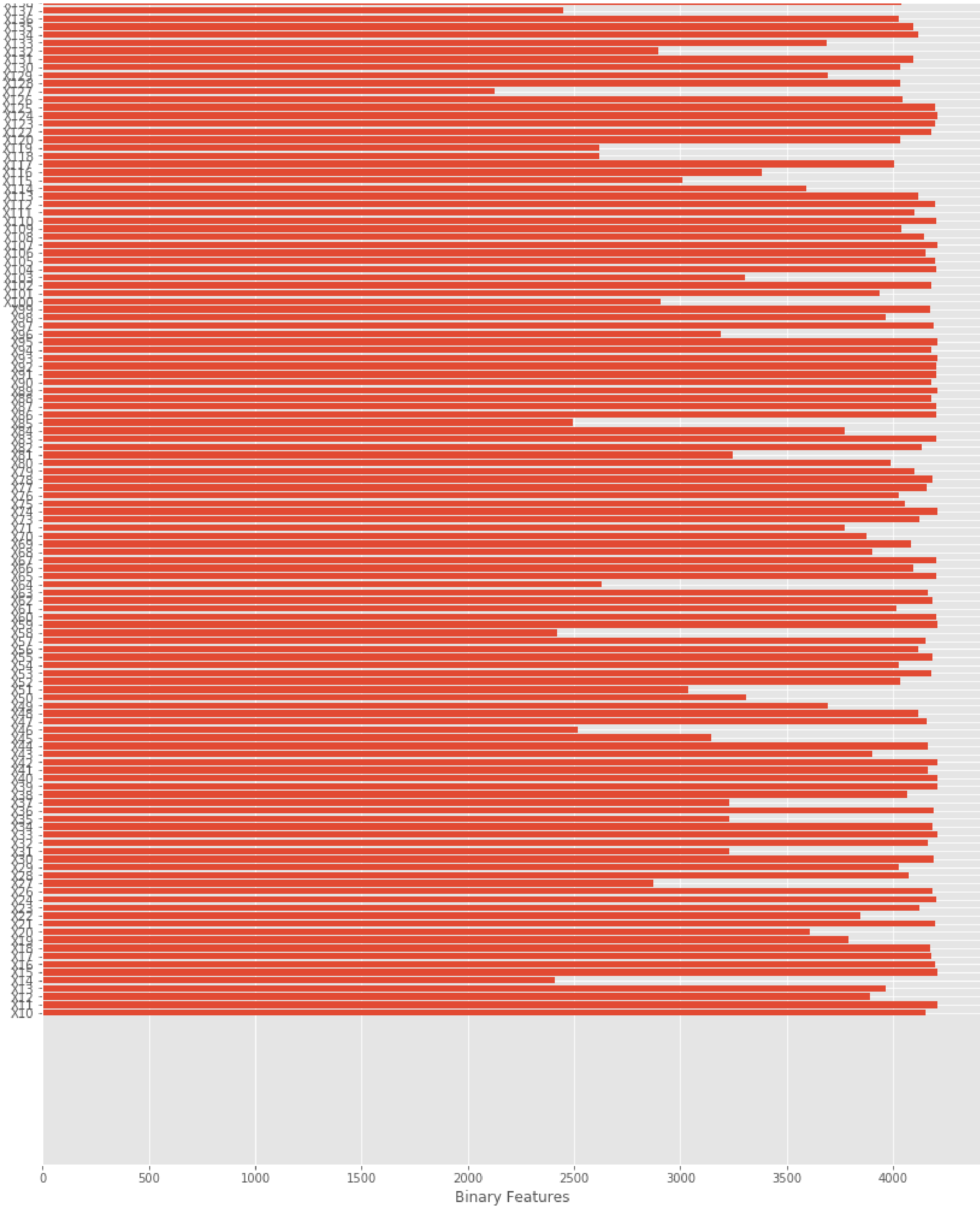
In [0]:

```
# plt.style.available
# plt.figure(figsize=(16,8))

plt.style.use('ggplot')
fig, ax = plt.subplots(figsize=(14,50))
plt.barh(list(bar_dict_0.keys()) , list(bar_dict_0.values()))
# df.plot(kind='barh', legend = False, ax=ax)
ax.set_xlabel('Binary Features')
ax.set_ylabel('No of "0" in each features')
plt.title("Binary features Zero Values")
plt.show()
```

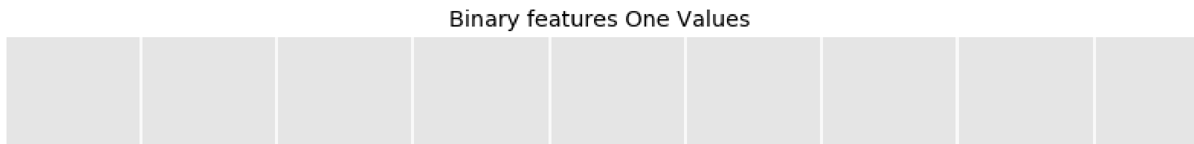


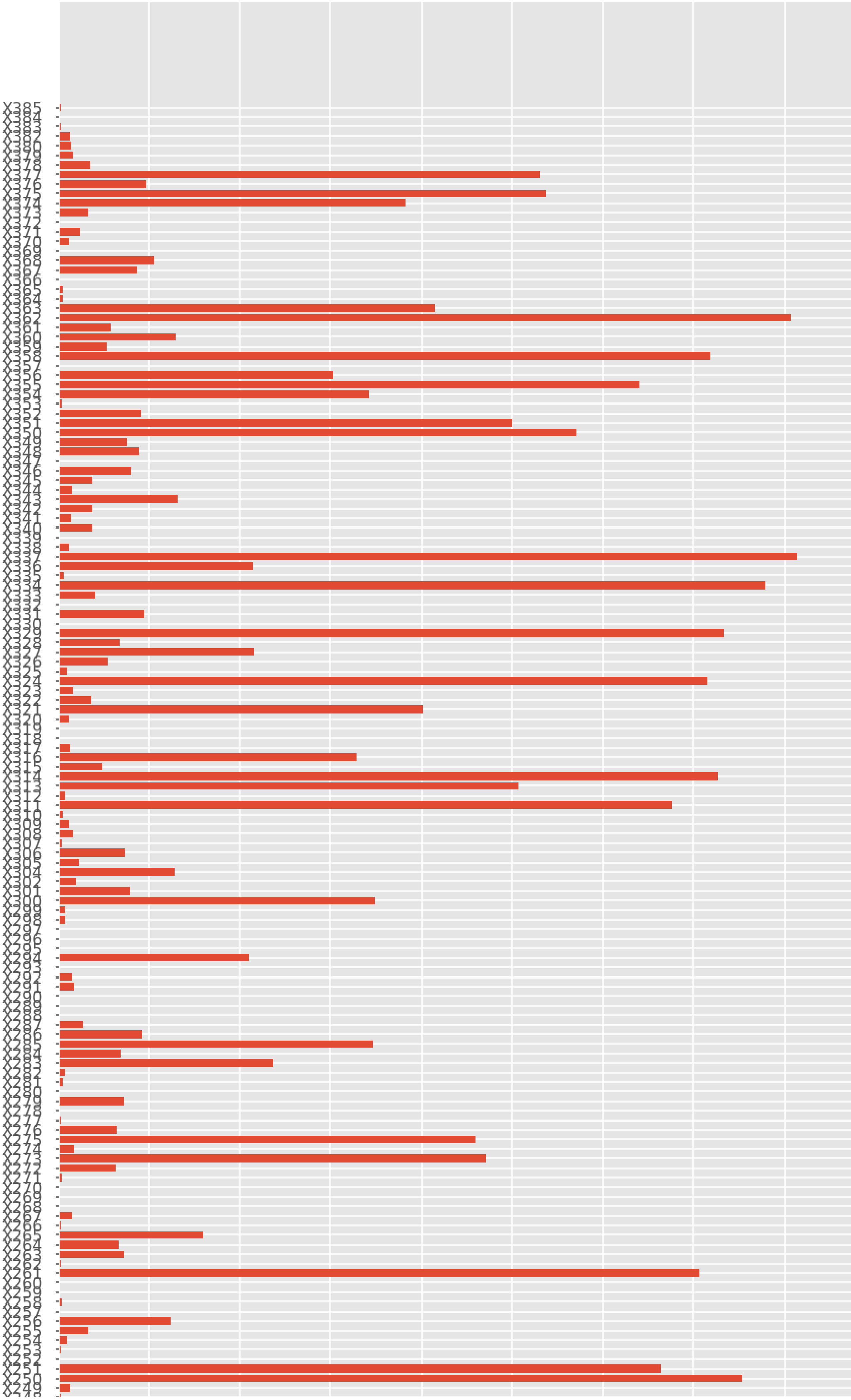

No of "0" in each features

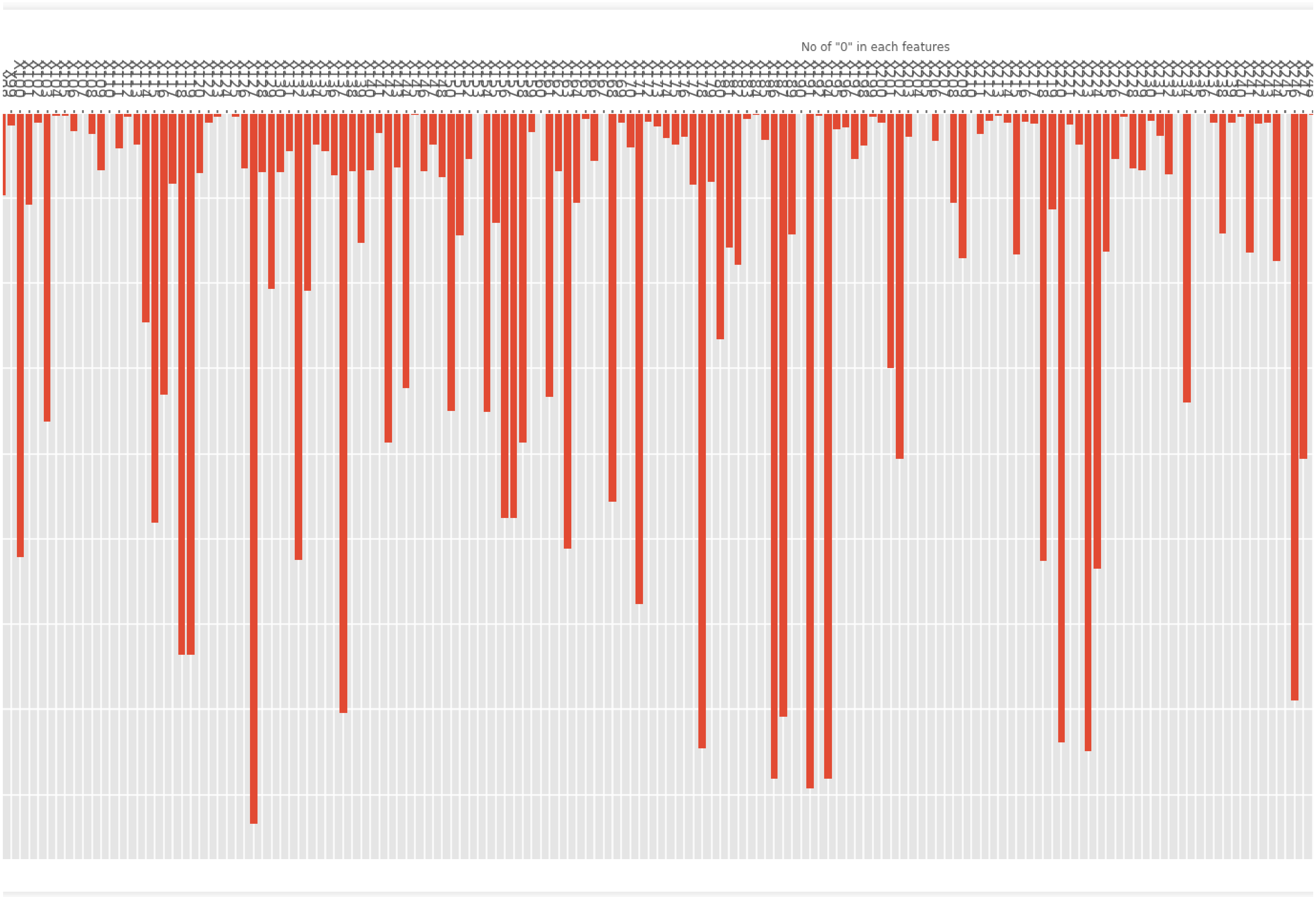


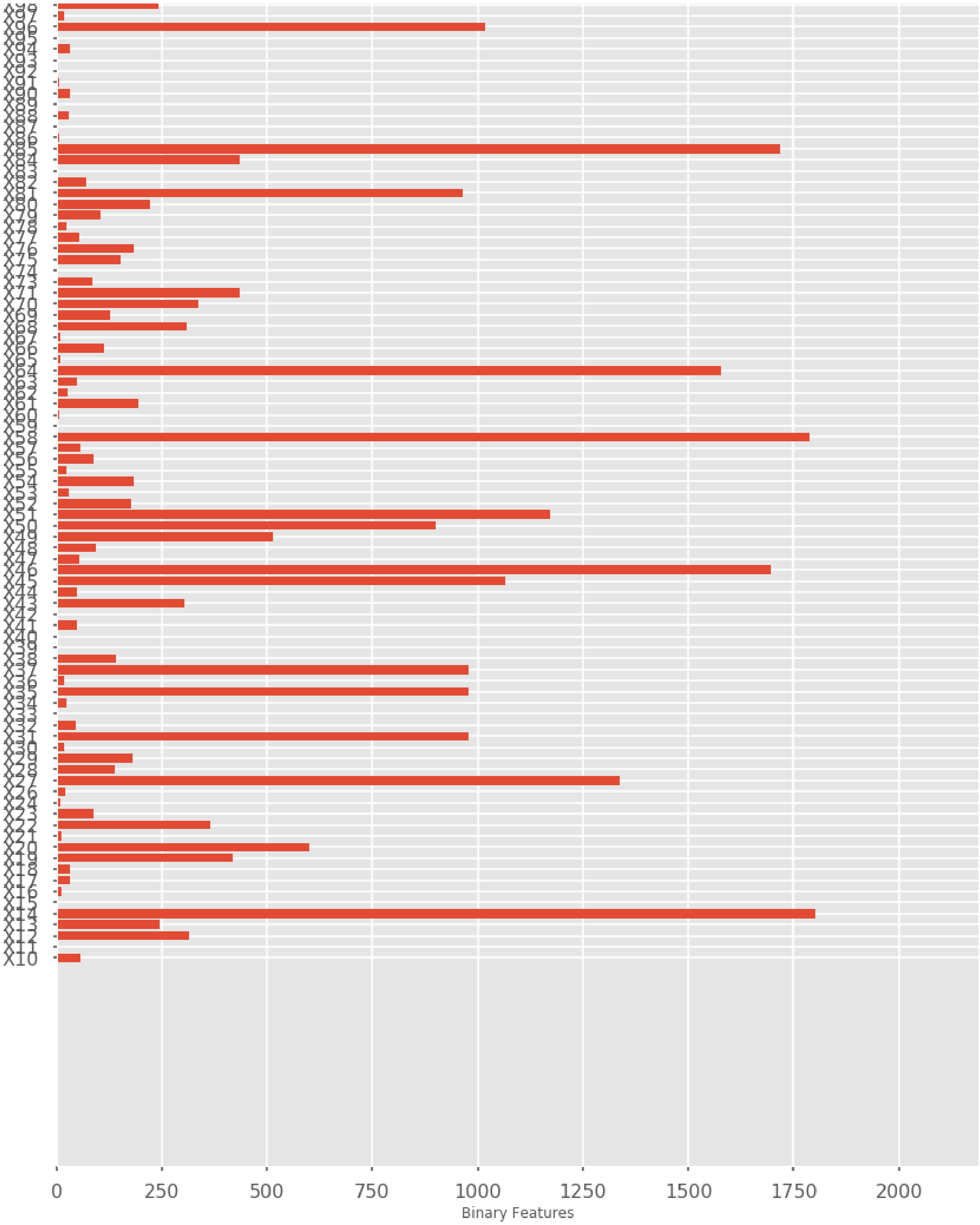
In [0]:

```
plt.style.use('ggplot')
fig, ax = plt.subplots(figsize=(14,70))
plt.barh(list(bar_dict_1.keys()) , list(bar_dict_1.values()))
# df.plot(kind='barh', legend = False, ax=ax)
ax.set_xlabel('Binary Features')
ax.set_ylabel('No of "0" in each features')
plt.title("Binary features One Values")
plt.show()
```






No of "0" in each features



In [0]:

```
Total_one = len(bar_dict_1.values())
Lessthan_10 = len([i for i in bar_dict_1.values() if i==0])
print(f"Percentage of binary features which contain less one values {Lessthan_10*100/Total_one}%")
```

```
Percentage of binary features which contain less one values 3.260869565217391%
```

In [0]:

```
All_zeroes = [i for i,k in bar_dict_1.items() if k==0]
print(All_zeroes)
'''All zero coloumns are above and it's good to remove these features as they are not adding that
much importance to the Y value :'''
```

['X11', 'X93', 'X107', 'X233', 'X235', 'X268', 'X289', 'X290', 'X293', 'X297', 'X330', 'X347']

Out[0]:

"All zero coloumns are above and it's good to remove these features as they are not adding that much importance to the Y value :"

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

My Thought Process :

1. There is no binary feature which doesnot contain zero.

2. There are features which only contain zero.

3. 'X11', 'X93', 'X107', 'X233', 'X235', 'X268', 'X289', 'X290', 'X293', 'X297', 'X330', 'X347', Features which only contain zero value.

4. we can remove above mention features from our models as these features will not contribute in our predictions as no correlation , Is it theese features don't have any correlation ? let's check the correlation of these features with our Y value

****

1.4. Correlation between independent features and dependent features(pearson correlation)

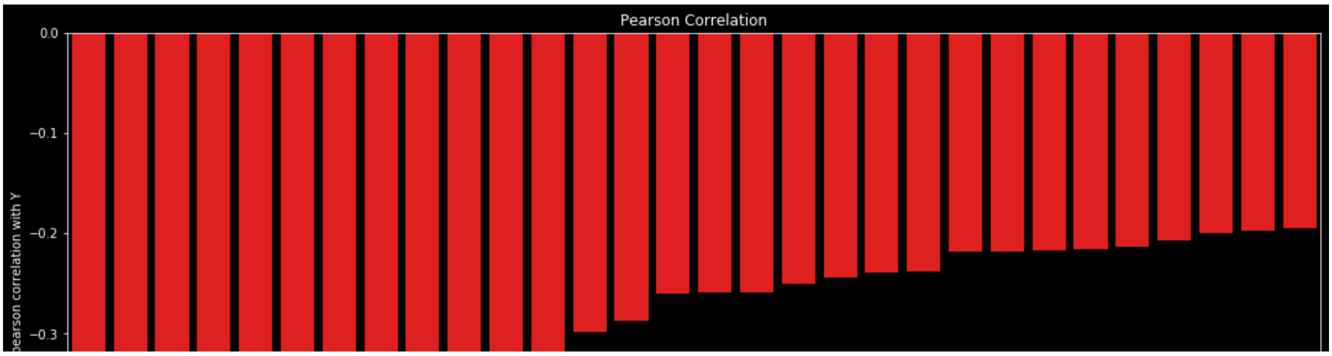
In [58]:

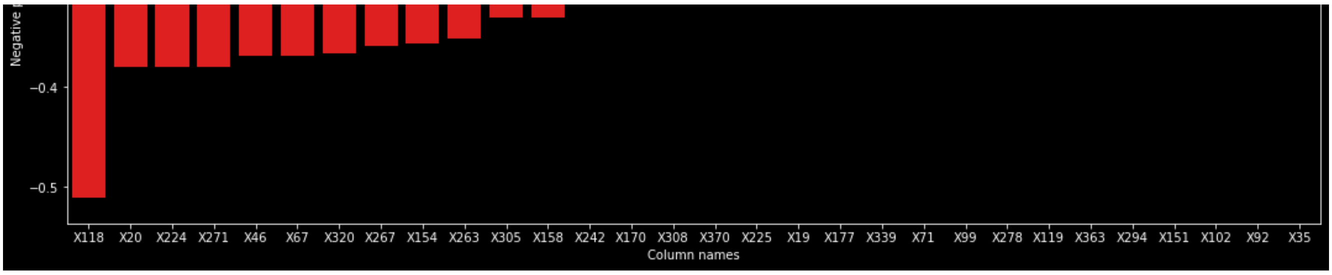
```
from scipy.stats import pearsonr
Correlation = train.corr()
Correlation = pd.DataFrame(Correlation['y'] )
Correlation.dropna(inplace=True,axis=0)
Zero_correlation = ['X11', 'X93', 'X107', 'X233', 'X235', 'X268', 'X289', 'X290', 'X293', 'X297', 'X330', 'X347']

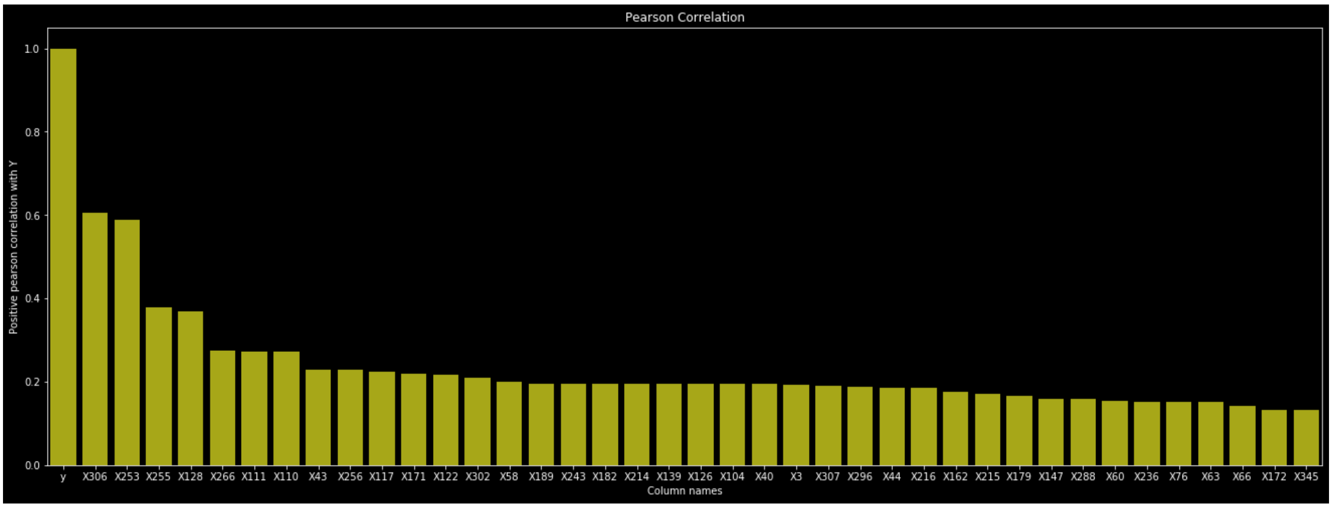
zipped = zip([i for i in train.columns if i not in Zero_correlation],[i[0] for i in Correlation.values.tolist()])
# Using sorted and lambda
res = sorted(zipped, key = lambda x: x[1])

plt.style.use('dark_background')
plt.figure(figsize=(40,8))
plt.subplot(1,2,1)
sns.barplot([i[0] for i in res][:30],[i[1] for i in res][:30],color = 'r')
plt.xlabel("Column names")
plt.ylabel("Negative pearson correlation with Y")
plt.title("Pearson Correlation")
plt.show()

plt.figure(figsize=(50,8))
plt.subplot(1,2,2)
sns.barplot([i[0] for i in res][::-1][:40],[i[1] for i in res][::-1][:40],color = 'y')
plt.xlabel("Column names")
plt.ylabel("Positive pearson correlation with Y")
plt.title("Pearson Correlation")
plt.show()
```

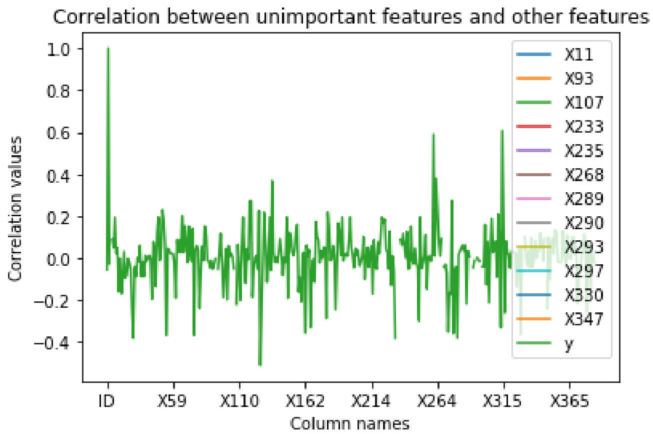






In [54]:

```
Correlation = train.corr()
Correlation = Correlation[['X11', 'X93', 'X107', 'X233', 'X235', 'X268', 'X289', 'X290', 'X293', 'X
297', 'X330', 'X347','y']]
Correlation.plot()
plt.title("Correlation between unimportant features and other features")
plt.xlabel("Column names")
plt.ylabel("Correlation values")
plt.show()
```



<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

My Thought Process :

```
1. Pearson correlation : Positive value signifies linear dependency like when feature
increases dependent variable also increases and negative values of correlation signifies li
ke when one increase dependent variable decreases

2. We can see red bar graph shows negative correlation of all features with Y features, i s
elected only top  most values to see visually

3. We can see green bar graph shows positive  correlation of all features with Y features,
i selected only top  most values to see visually.
```

4. Last graph shows that there is not correlation between 'X11', 'X93', 'X107', 'X233', 'X235', 'X268', 'X289', 'X290', 'X293', 'X297', 'X330', 'X347' features as i can't see any other color in the graph other than green which signifies Y values correlation with other features.

5. We can remove these features.

6. From the graph above we can see ID feature has -.005 correlation with y so will keep it but will standardize it as it is of higher scale..

2. Data Cleaning

For data cleaning i have 5 thought process to try with, I will try each process one by one. Please see below....

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

Data Cleaning My Thought Process 1.: Removing more than 150 sec values from the dependent variable y and impute means of train['y'] only
Data Cleaning My Thought Process 2.: Removing more than 150 sec values from the dependent variable y and impute means of train['y'] and removing the unimportant features 'X11', 'X93', 'X107', 'X233', 'X235', 'X268', 'X289', 'X290', 'X293', 'X297', 'X330', 'X347'

In [29]:

```
"""My Thought Process 1."""
# Clipping fo our y values till 150
clipped_y  =[]
# Imputing the value higher than 150 with mean of the train['y'] i.e. 100 approx.
[clipped_y.append(np.mean(train['y'])) if i>150 else clipped_y.append(i) for i in train['y']]
train['y'] = clipped_y

actual_y = train["y"]
# Dropping the dependent variable form the train dataframe.
train.drop("y",inplace=True,axis=1)
```

In [18]:

```
"""My Thought Process 2."""
# Clipping fo our y values till 150
clipped_y  =[]
# Imputing the value higher than 150 with mean of the train['y'] i.e. 100 approx.
[clipped_y.append(np.mean(train['y'])) if i>150 else clipped_y.append(i) for i in train['y']]
train['y'] = clipped_y

actual_y = train["y"]
# Dropping the dependent variable form the train dataframe.
train.drop("y",inplace=True,axis=1)

train.drop(['X11', 'X93', 'X107', 'X233', 'X235', 'X268', 'X289', 'X290', 'X293', 'X297', 'X330', '
X347'],inplace=True,axis = 1)
```

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

Data Cleaning My Thought Process 3.: Removing oulier 265.32 values from the dependent variable y and impute means of train['y'] only

In [143]:

```
"""My Thought Process 3."""
# Clipping fo our y values till 150
clipped_y  =[]
```

```
# Imputing the value higher than 150 with mean of the train['y'] i.e. 100 approx.
[clipped_y.append(np.mean(train['y'])) if i>250 else clipped_y.append(i) for i in train['y']]
train['y'] = clipped_y

actual_y = train["y"]
# Dropping the dependent variable form the train dataframe.
train.drop("y",inplace=True,axis=1)
```

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

Data Cleaning My Thought Process 4.: Removing oulier 265.32 values from the dependent variable y and impute with different values and check the kaggle score, At last i got 130 as the best value to immpute the outlier point with.

In [160]:

```
"""My Thought Process 5."""
# Clipping fo our y values till 150
clipped_y  =[]
# Imputing the value higher than 150 with mean of the train['y'] i.e. 100 approx.
[clipped_y.append(130) if i>180 else clipped_y.append(i) for i in train['y']]
train['y'] = clipped_y

actual_y = train["y"]
# Dropping the dependent variable form the train dataframe.
train.drop("y",inplace=True,axis=1)
```

3. Data pre-processing

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

My Thought Process How to encode these catagorical features, let's encode in two ways 1. Label Encoding 2. One hot Encoding, I will select the best working encoding technique.

In [161]:

```
def OneHot_encoding_function(train,test):
    """This function is written to get the one hot encoded value of the catagorical features
        Author : Lucky Chauhan
        Date : 27-03-2020"""
    for c in tqdm(train.columns):
        if train[c].dtype == 'object': # Taking only the catagorical features form the dataframe
            lbl = OneHotEncoder() # calling one hot encoder
            lbl.fit(np.array(train[c].values).reshape(-1, 1).tolist() + np.array(test[c].values).res
hape(-1, 1).tolist())
            # Fitting one hot encoder for train and test both as we know the test data and we can
fit test data aslo to generate vocabulary
            # though we don't do it like that in real life problems but it's a kaggle problem and
the main motive is to
            # increase the test private and public score
            Encoded_category = lbl.transform(np.array(train[c].values).reshape(-1, 1))
            # tranforming the train into one hot encoded
            train.drop(c,inplace = True,axis = 1) # dropping the column name.
            columns_ = []
            for i in range(Encoded_category.shape[1]):
                columns_.append(c +"_" +str(i))# Generating the column name.
            # Adding the column name to the dataframe.
            train = pd.concat([train, pd.DataFrame(Encoded_category.toarray(),columns=columns_)], a
xis=1, sort=False)
            # Tranforming th test values into one hot encoded values also.
            Encoded_category = lbl.transform(np.array(test[c].values).reshape(-1, 1))
            columns_ = []
            for i in range(Encoded_category.shape[1]):
                columns_.append(c +"_" +str(i))# Generating the column name.
            test.drop(c,inplace = True,axis = 1)
            # Adding the column name to the dataframe.
            test = pd.concat([test, pd.DataFrame(Encoded_category.toarray(),columns=columns_)], axi
s=1, sort=False)

    return [train,test]
```

```
def Label_encoding_function(train,test):
    """This function is written to get the Label encoder value of the catagorical features
       Author : Lucky Chauhan
       Date : 27-03-2020
    """
    for c in tqdm(train.columns):
       if c in ['X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8']:
           lbl = LabelEncoder() # Initialising the labelencoder
           lbl.fit(list(train[c].values)+ list(test[c].values)) # fitting labelencoder with train a
md test both.
           train[c] = lbl.transform(list(train[c].values)) # tranforming the train dataframe catag
orical coloumn
           test[c] = lbl.transform(list(test[c].values)) # tranforming the test dataframe catagori
cal coloumn
    return [train,test]

b = Label_encoding_function(train,test)# calling the Label encodiung function defined above
train = b[0]
test = b[1]

# b = OneHot_encoding_function(train,test)
# train = b[0]
# test = b[1]
scaled_train = train
scaled_test = test
```

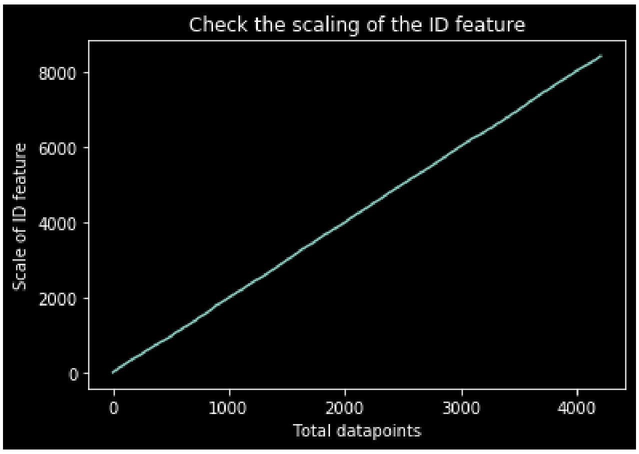
4. Data Decomposition

In [145]:

```
def Decomposition_explained_variance(title,variance,component):
    """Return the graph of the explained variance of the PCA and TSVD
    Author : Lucky Chauhan
    Date : 27-03-2020"""
    plt.figure(figsize=(6,4))
    plt.title(title)
    X = [i for i in range(1,300)]
    plt.plot(X,variance)
    plt.axvline(x=component,color = 'r',dash_capstyle = 'round')
    plt.xlabel("Eigen Vectors")
    plt.xticks([i for i in range(1,300,10)])
    plt.ylabel("Explained variance")
    return plt
```

In [125]:

```
pd.Series(np.sort(train['ID'])).plot()
plt.title("Check the scaling of the ID feature")
plt.xlabel("Total datapoints")
plt.ylabel("Scale of ID feature")
plt.show()
```



<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

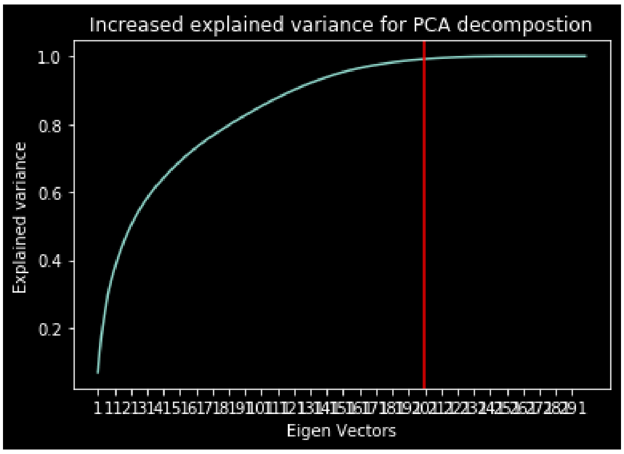
<u>My Thought Process</u> I will apply now PCA,TSVD etc. but wait scale of the features affect the expained variance so before applying PCA let's do scaling of the catagorical data which is now label encoded. But which scaling should i use standerscale,minmax scal,normalization ?, In all linear model, data is first scaled than only feed into the model, so i will be using standardscaler to feed into the linear model same will be used here..

In [153]:

```
columns_ = train.columns
std_scalar = StandardScaler()
scaled_train = std_scalar.fit_transform(train)
scaled_test = std_scalar.fit_transform(test)
scaled_train = pd.DataFrame(scaled_train,columns=columns_)
scaled_test = pd.DataFrame(scaled_test,columns=columns_)
```

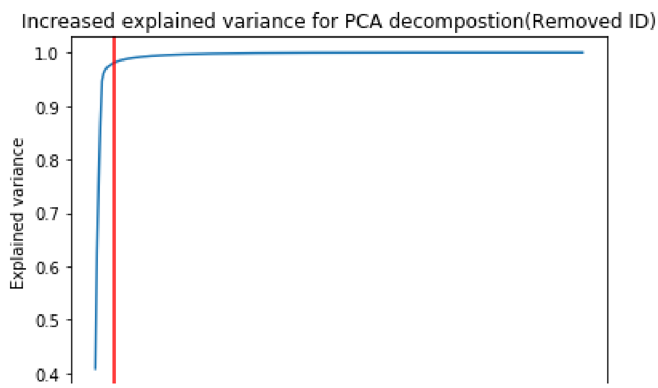
In [151]:

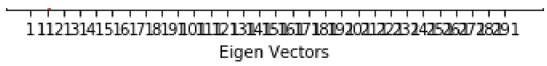
```
PCA_variance = []
for i in range(1,300):
    pca = PCA(n_components=i, random_state=420)
    pca2_results_train = pca.fit_transform(scaled_train)
    PCA_variance.append(pca.explained_variance_ratio_.sum())
plotting = Decomposition_explained_variance("Increased explained variance for PCA decompostion",PC
A_variance)
plotting.show()
```



In [8]:

```
PCA_variance = []
for i in range(1,300):
    pca = PCA(n_components=i, random_state=420)
    pca2_results_train = pca.fit_transform(scaled_train.drop("ID",axis = 1))
    PCA_variance.append(pca.explained_variance_ratio_.sum())
plotting = Decomposition_explained_variance("Increased explained variance for PCA
decompostion(Removed ID)",PCA_variance,12)
plotting.show()
```





In [142]:

```
print(PCA_variance[::-1][:10])
```

```
[0.9909105437894763, 0.9904915003704913, 0.990075492388566, 0.9896362100208143,
0.9891898246124341, 0.9887346844593898, 0.9882983257855456, 0.9878164006003525,
0.9873309361733401, 0.9867871250867614]
```

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process Scaled features has best explained features number = 200 and unscaled features has best explained features number = 12, Please sea above

In [162]:

```
import copy
# from above plot we are taking 12 n_components
n_comp = 12
# from above plot for unscaled features we are n_componets value = 200
# n_comp = 200

def decomposed_features(train_,test_):
    """
     This function is used to decomposed the features into lower dimensions by using different
     dimnesional reduction techniques.
     1) TSVD
     2) PCA
     3) ICA
     4) GRP
     5) SRP
    """
    # tSVD
    tsvd = TruncatedSVD(n_components=n_comp, random_state=420)
    tsvd_results_train = tsvd.fit_transform(train_)
    tsvd_results_test = tsvd.transform(test_)

    # PCA
    pca = PCA(n_components=n_comp, random_state=420)
    pca2_results_train = pca.fit_transform(train_)
    pca2_results_test = pca.transform(test_)

    # ICA
    ica = FastICA(n_components=n_comp, random_state=420)
    ica2_results_train = ica.fit_transform(train_)
    ica2_results_test = ica.transform(test_)

    # GRP
    grp = GaussianRandomProjection(n_components=n_comp, eps=0.1, random_state=420)
    grp_results_train = grp.fit_transform(train_)
    grp_results_test = grp.transform(test_)

    # SRP
    srp = SparseRandomProjection(n_components=n_comp, dense_output=True, random_state=420)
    srp_results_train = srp.fit_transform(train_)
    srp_results_test = srp.transform(test_)

    #save columns list before adding the decomposition components

    usable_columns = list(set(train_.columns) - set(['y']))

    # Append decomposition components to datasets
    for i in range(1, n_comp + 1):
        #below code is used to add the resultant decomposed features vertically(i.e we added 12
more coloumn in our original data)
        train_['pca_' + str(i)] = pca2_results_train[:, i - 1]
        #below code is used to add the resultant decomposed features vertically(i.e we added 12
more coloumn in our original data
        test_['pca_' + str(i)] = pca2_results_test[:, i - 1]
         #below code is used to add the resultant decomposed features vertically(i.e we added 12
more coloumn in our original data
```

```
        train_['ica_' + str(i)] = ica2_results_train[:, i - 1]
        #below code is used to add the resultant decomposed features vertically(i.e we added 12 more coloumn in our original data
        test_['ica_' + str(i)] = ica2_results_test[:, i - 1]

        train_['tsvd_' + str(i)] = tsvd_results_train[:, i - 1]
        test_['tsvd_' + str(i)] = tsvd_results_test[:, i - 1]

        train_['grp_' + str(i)] = grp_results_train[:, i - 1]
        test_['grp_' + str(i)] = grp_results_test[:, i - 1]

        train_['srp_' + str(i)] = srp_results_train[:, i - 1]
        test_['srp_' + str(i)] = srp_results_test[:, i - 1]
    return [train_,test_]
# we are creating a deep copy in the memory one:
# 1) original features
# 2)other are original+decomposed features
decomposed_train = copy.deepcopy(scaled_train)
decomposed_test = copy.deepcopy(scaled_test)
decomposed_train,decomposed_test = decomposed_features(decomposed_train,decomposed_test)# This function is created above

# fixing coloum datatype
columns = scaled_train.columns
scaled_train[columns] = scaled_train[columns].apply(pd.to_numeric)
scaled_test[columns] = scaled_test[columns].apply(pd.to_numeric)

print(f"Train value : {scaled_train.shape}")
print(f"Test value : {scaled_test.shape}")
print(f"Decomposed_Train value : {decomposed_train.shape}")
print(f"DEcomposed_Test value : {decomposed_test.shape}")
```

```
Train value : (4209, 377)
Test value : (4209, 377)
Decomposed_Train value : (4209, 437)
DEcomposed_Test value : (4209, 437)
```

5. Machine Learning Model Architecture

<img src = "./Image.PNG" ></img>

5.1 All features models

5.1.1 Linear Regression with Ridge

5.1.2 Linear Regression with Lasso

5.1.3 Linear Regression with Elsatic net

5.1.4 Linear Regression with LARSLasso

5.1.5 RANSAC Regressor

5.1.6 Decision tree

5.1.7 SVR

5.1.8 XGBOOST

5.1.9 GBDT

5.1.10 Stacking model with best model

5.1.11 Voting Regressor with best model

5.1.12 Deep Learning model

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

Let define some functions which we will be reusing.....

In [157]:

```
def ElasticNet_(alpha,train_df):
    """This function hypertune our Elastic net model and create a plot based on the tuning"""
    train_scores = []
    test_scores = []
    alpha_values = []
    for i_alpha in tqdm(alpha):
        linear_clf = ElasticNet(alpha=i_alpha, fit_intercept=True, normalize=False,random_state=23)

        Scores = cross_validate(linear_clf, train_df, actual_y, cv=10,scoring=('r2'),\
                                return_train_score=True)
        train_scores.append(np.mean(Scores['train_score']))
        test_scores.append(np.mean(Scores['test_score']))
        alpha_values.append(i_alpha)
    plt.title("Elastic Net Linear Model")
    plt.plot(alpha_values,train_scores)
    plt.plot(alpha_values,test_scores)
    plt.scatter(alpha_values,test_scores)
    plt.xlabel("Alpha values")
    plt.ylabel("Loss")
    return plt

def Ridge_regression(alpha,train_df):
    """This function hypertune our Ridge model and create a plot based on the tuning"""
    train_scores = []
    test_scores = []
    alpha_values = []
    for i_alpha in tqdm(alpha):
        linear_clf = Ridge(alpha=i_alpha, fit_intercept=True, normalize = False,random_state=23)

        Scores = cross_validate(linear_clf, train_df, actual_y, cv=10,scoring=('r2'),\
                                return_train_score=True)
        train_scores.append(np.mean(Scores['train_score']))
        test_scores.append(np.mean(Scores['test_score']))
        alpha_values.append(i_alpha)
    plt.title("Ridge Linear Model")
    plt.plot(alpha_values,train_scores)
    plt.plot(alpha_values,test_scores)
    plt.scatter(alpha_values,test_scores)
    plt.xlabel("Alpha values")
    plt.ylabel("Loss")
    return plt

def Lasso_regression(alpha,train_df):
    """This function hypertune our Lasso model and create a plot based on the tuning"""
    train_scores = []
    test_scores = []
    alpha_values = []
    for i_alpha in tqdm(alpha):
        # Initialized Lasso regressor, which enables L1 regularization and help our model learning
coefficients to penalizde...
        linear_clf = Lasso(alpha=i_alpha, fit_intercept=True, normalize=False,random_state=23)
        """ PLEASE READ ME"""
        # Croos validatrion is happening here for 10 fold, i am using more no of k fold so that
our model generalize well
        # and moreover we have less datapoints also so enable more generalizsed and robust model i
am using 10 k fold, we can use more no
        # of folds also to make it more robust.
        # my main motive is to reduce my fluctuation in all 10 folds testing set, because in
kaggle they have 19% dtaa as public
        # remaining 79% data as private, to get good score in private we have to get some minimum
difference in the
        # score of traiing and test dataset of all k folds.
        """READ ME END"""
        Scores = cross_validate(linear_clf, train_df, actual_y, cv=10,scoring=('r2'),\
                                return_train_score=True)
        train_scores.append(np.mean(Scores['train_score']))
```

```
        test_scores.append(np.mean(Scores['test_score']))
        alpha_values.append(i_alpha)

    # Creating a graph to understand our train test loss
    plt.title("Lasso Linear Model")
    plt.plot(alpha_values,train_scores)
    plt.plot(alpha_values,test_scores)
    plt.scatter(alpha_values,test_scores)
    plt.xlabel("Alpha values")
    plt.ylabel("Loss")
    return plt

def decision_tree(train_df):
    """This function hypertune our DEcisiontree model and create a plot based on the tuning"""
    Decision_tree_params = {
        'criterion': ["mse", "friedman_mse", "mae"],
        'max_depth': [1,2,3,4,5,6,7,8,9,10],
        'min_samples_split': [2,3,4,5,6,7,8,9],
        'max_leaf_nodes' : [1,5,15,30,45,50,100,300,200,500,1000]
    }

    DECISONTREE = DecisionTreeRegressor(random_state=2)
    DECISONTREE.fit(train_df,actual_y)

    Decsion_clf = RandomizedSearchCV(DECISONTREE, Decision_tree_params,n_jobs=-1, verbose=2, cv= 10
,
                               scoring='r2', random_state=2,return_train_score=True)

    Decsion_clf.fit(train_df,actual_y)

    params_number = 0
    params_number_list = []
    # Lists which contain the model R^2 scores.
    train_scores = []
    test_scores = []
    test_result = Decsion_clf.cv_results_["mean_test_score"]
    train_result = Decsion_clf.cv_results_["mean_train_score"]
    for i in Decsion_clf.cv_results_['params']:
        test_scores.append(test_result[params_number])
        train_scores.append(train_result[params_number])
        print(f"params no {params_number} : {i} test score : {test_scores }")
        params_number+=1
        params_number_list.append(params_number)

    plt.title("Decision Tree")
    plt.plot(params_number_list,train_scores)
    plt.plot(params_number_list,test_scores)
    plt.scatter(params_number_list,test_scores)
    plt.xlabel("C values")
    plt.ylabel("Loss")
    return [plt,Decsion_clf]

def best_decison_tree(DECISONTREE,train_df):
    """Takes the tuned model and gives the fitted model"""
    decision_classfier = DECISONTREE
    decision_classfier.fit(train_df,actual_y)
    r_square = r2_score(actual_y,decision_classfier.predict(train_df))
    RMSE = mean_squared_error(actual_y,decision_classfier.predict(train_df),squared=False)
    print(f"R_square for train data is : {r_square}")
    print(f"RMSE for train data is : {RMSE}")
    return decision_classfier

def SVR_Regression(train_df,C_values,linearity):
    """This function will plot the SVR model with hyperparameters and loss"""
    train_scores = []
    test_scores = []
    c_values = []
    for i in tqdm(C_values):
        SVR_MODEL = SVR(kernel=linearity, degree=3, gamma='scale', C = i, epsilon=0.2,\
            verbose=3, max_iter=-1)
        SVR_MODEL.fit(train_df,actual_y)

        Scores = cross_validate(SVR_MODEL, train_df, actual_y, cv=5,scoring=('r2'),\
                                return_train_score=True)
        train_scores.append(np.mean(Scores['train_score']))
        test_scores.append(np.mean(Scores['test_score']))
        c_values.append(i)
```

```python
    plt.title("SVR Model")
    plt.plot(c_values,train_scores)
    plt.plot(c_values,test_scores)
    plt.scatter(c_values,test_scores)
    plt.xlabel("C values")
    plt.ylabel("Loss")
    return plt

def SVR_MODEL_FIT(SVR_MODEL):
    """This function will find the best model and generate predction so that we can find our kaggl
e score"""
    SVR_MODEL.fit(scaled_train,actual_y)

    r_square = r2_score(actual_y,SVR_MODEL.predict(scaled_train))
    RMSE = mean_squared_error(actual_y,SVR_MODEL.predict(scaled_train),squared=False)
    print(f"R_square for train data is : {r_square}")
    print(f"RMSE for train data is : {RMSE}")

    #lET'S FIND THE KAGGLE SCORE.
    sub = pd.DataFrame()
    sub['ID'] = test['ID']
    sub['y'] = SVR_MODEL.predict(scaled_test)
    sub.to_csv('submission_Final.csv', index=False)
    print("Submission_Final.csv Generated")



def XGBOOST_Tuning(train_df_train,train_df_test):
    '''Cross validation the xgb model then predict the test data'''
    max_depths = [3,4]
    n_treess = [100,400,520]
    etas = [.001,.0045]
    subsamples = [.93,.95]
    count = 0
    dtrain = xgb.DMatrix(train_df_train, actual_y)
    dtest = xgb.DMatrix(train_df_test)

    # GRID SEARCH
    for max_depth in max_depths:
        for n_trees in n_treess:
            for eta in etas:
                for subsample in subsamples:
                    xgb_params = {
                                'n_trees': n_trees,
                                'max_depth': max_depth,
                                'eta': eta,
                                'subsample': subsample,
                                'objective': 'reg:linear',
                                'eval_metric': 'rmse',
                            }
                    print(f"Parameters are :{max_depth,n_trees,eta,subsample}")
                    print(f"Total iteration :
{len(max_depths)*len(n_treess)*len(etas)*len(subsamples)}")
                    print(f"Total iteration remaining :
{len(max_depths)*len(n_treess)*len(etas)*len(subsamples) - (count)}")
                    print("#"*110)
                    count+=1
                    # NOTE: Make sure that the class is labeled 'class' in the data file
                    num_boost_rounds = 1700
                    XGBOOST_CV = xgb.cv(xgb_params, dtrain, nfold=5, verbose_eval=3,early_stopping_r
ounds=5, num_boost_round=num_boost_rounds)
                    print("#"*110)

def XGBOOST_best_fit_model(xgb_params,booster):
    """HYperparaemter tiuning for XGBOOST Model"""
    dtrain = xgb.DMatrix(scaled_train, actual_y)
    dtest = xgb.DMatrix(scaled_test)

    # NOTE: Make sure that the class is labeled 'class' in the data file
    num_boost_rounds = booster
    # train model
    model = xgb.train(dict(xgb_params, silent=0), dtrain, num_boost_round=num_boost_rounds)
    y_pred_train = model.predict(dtrain)
    y_pred = model.predict(dtest)
    print(f"(r2  : {r2_score(actual_y,y_pred_train)} and mean_squared_error
{mean_squared_error(actual_y,y_pred_train,squared=False)})  ")
```

```
from sklearn.linear_model import SGDRegressor

def SGD_Regressor(train_df,test_df):
    """Using SGD REgressor"""
    alpha= [.000001,.00001,.0001,.001,.01,.1,1]
    losses = ['huber','squared_loss']
    train_scores = []
    test_scores = []

    for i in tqdm(alpha):
        for loss in losses:
            for j in ['l1','l2']:
                SGD_clf = SGDRegressor(loss= loss, penalty= j , alpha= i)
                SGD_clf.fit(train_df,actual_y)
                Scores = cross_validate(SGD_clf, train_df, actual_y,
cv=5,scoring=('r2'),return_train_score=True)
                train_scores.append(np.mean(Scores['train_score']))
                test_scores.append(np.mean(Scores['test_score']))
                print(f"parameters :alpha,losses,regularization : {i,loss,j}")
                print(f"Train score : {np.mean(Scores['train_score'])} and Test score : {np.mean(Sc
ores['test_score'])}")

def GBDT_Regression(trian_df,test_df):

    GBDT_params = {
    'learning_rate': [.00045,.0045,.001,.0025,.007,.001,.02,.01],
    'max_depth': [2,3,4,5,6,7,8,9],
    'max_features': [.2,.3,.4,.5,.55,.7,.9],
    'min_samples_leaf': [1,2,3,4,5,6,7,8,9,10,15,20],
    'min_samples_split': [2,3,4,5,6,7,8,9,10],
    'subsample': [.1,.2,.4,.5,.6]
    }

    GBDT_clf = GradientBoostingRegressor()


    GBDT_clf = RandomizedSearchCV(GBDT_clf, GBDT_params, n_iter=20,
                                n_jobs=-1, verbose=2, cv= 5,
                                scoring='r2', random_state=2,return_train_score=True)

    GBDT_clf.fit(trian_df,actual_y)

    count = 0
    test_result = GBDT_clf.cv_results_["mean_test_score"]
    train_result = GBDT_clf.cv_results_["mean_train_score"]
    for i in GBDT_clf.cv_results_['params']:
        print(f"params : {i} and it's test r2 score is {test_result[count]} and it's train r2 score
is {train_result[count]}")
        count+=1

    best_score = GBDT_clf.best_score_
    best_params = GBDT_clf.best_params_
    best_estimator = GBDT_clf.best_estimator_
    print("Best score: {}".format(best_score))
    print("Best params: ")
    for param_name in sorted(best_params.keys()):
        print('%s: %r' % (param_name, best_params[param_name]))

    GBDT_model = best_estimator
    GBDT_model.fit(trian_df,actual_y)
    predicted_y = GBDT_model.predict(trian_df)
    print(f"GBDT best model result : {r2_score(actual_y,predicted_y)}")
    sub = pd.DataFrame()
    sub['ID'] = test['ID']
    sub['y'] = GBDT_model.predict(test_df)
    sub.to_csv('submission_Final.csv', index=False)
```

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

Attempt 1.

<u>My Thought Process:</u> I want to select that model which on hyperparameter tuning gets as closed result on test data also so that, our model will not behave badly on test data i.e Train loss as close as possible

on test data also so that, our model will not behave badly on test data i.e. Train loss as close as possible with test loss.

NOTE : Now eveything in blue is used in the subsequent model, we will check one by one all our analsys and will see the performance for eg: below we are using onnly 1.1 and 2.2 in the model

1. Y imputation

> **1.1 Removing above than 150 sec in Y values with mean of train['y'] i.e. 100 approx.**
>
> 1.2 Removing 12 unimportant features from the dataset and check what happend in the performance, i will check only with one model for checking purpose
>
> 1.3 Removing only 265.32 y values with mean of train['y] i.e 100 approx.
>
> 1.4 Removing only 265.32 y values with somwe other values other than 100 approx

2. Feature engineering

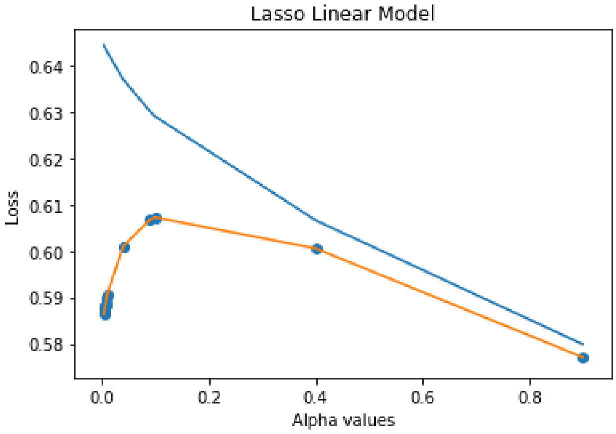
> **2.1 For catagorical values use label encoding**
>
> 2.2 For catagorical values use one hot encoding encoding
>
> 2.3 Remove ID and use best of the above encoding and see the performance, as ID as per the business problem may have some hidden sequencing information or may be not, we have to see.
>
> 2.4 I will fetch the best features by using all well known feture decompostiiton algorithm SVD,PCA etc.
>
> 2.5 Concatenate original features with decomposed features and do the analysis.

5.1.1 Linear Regression with Lasso

In [19]:

```
alpha = [.004,.005,.006,.0062,.0065,.0067,.0069,.007,.009,.01,.04,.09,.1,.4,.9]
plot = Lasso_regression(alpha)
plot.show()
```

```
100%|████████████████████████████████████████████████████████| 15/15
[03:00<00:00,  7.34s/it]
```



<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> [My Thought Process:](#) I am selecting .9 as tuned alpha value here.

In [52]:

```
linear_clf = Lasso(alpha=.9, fit_intercept=True, normalize=False,random_state=23)
linear_clf.fit(scaled_train,actual_y)
r_square = r2_score(actual_y,linear_clf.predict(scaled_train))
RMSE = mean_squared_error(actual_y,linear_clf.predict(scaled_train),squared=False)
print(f"R square for train data is : {r_square}")
```

```
print(f"RMSE for train data is : {RMSE}")
```

```
R_square for train data is : 0.579687053379915
RMSE for train data is : 7.761594512905049
```

In [59]:

```
# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = linear_clf.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

<!DOCTYPE html>

MODEL SUMMARY

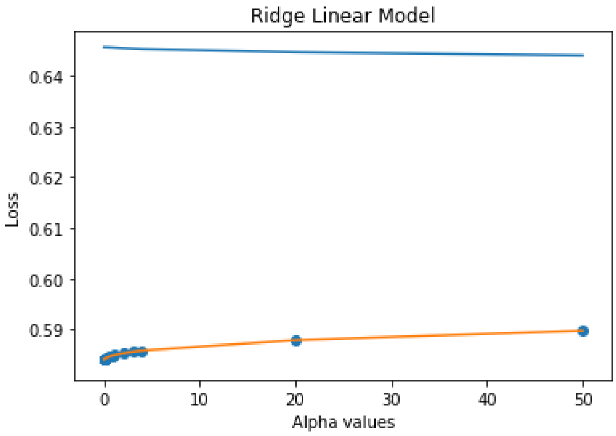
SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926

5.1.2 Linear Regression with ridge

In [18]:

```
alpha = [.000001,.00001,.0001,.0005,.001,.002,.003,.004,.005,.006,.0062,.0065,.0067,.0069,.007,.07,.09,.1,.2,.5,.7,.9,1,2,3,4,20,50]
plot = Ridge_regression(alpha)
plot.show()
```

```
100%|████████████████████████████████████████| 28/28
[00:15<00:00,  1.79it/s]
```



In [60]:

```
linear_clf = Ridge(alpha=.2, fit_intercept=True, normalize=True, max_iter=100,\
                            random_state=23)
linear_clf.fit(train,actual_y)
r_square = r2_score(actual_y,linear_clf.predict(train))
RMSE = mean_squared_error(actual_y,linear_clf.predict(train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")

# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = linear_clf.predict(scaled_test)
```

```
sub.to_csv('submission_Final.csv', index=False)
```

```
R_square for train data is : 0.6328477046898098
RMSE for train data is : 7.254169354373599
```

<!DOCTYPE html>

MODEL SUMMARY

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253

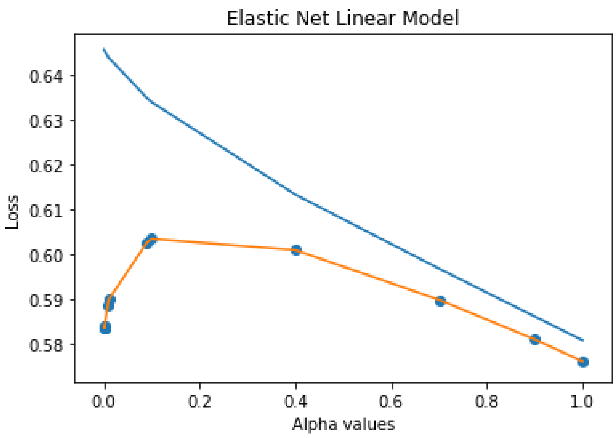
<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> <u>My Thought Process:</u> This is not performing well, so i will skip this algorithm for these features.As i have told you in starting i will selelct only that model which has minimum difference between train and test dataset

5.1.3 Linear Regression with Elsatic net

In [24]:

```
alpha = [.0000001,.00001,.0001,.0003,.0005,.0008,.001,.008,.01,.09,.1,.4,.7,.9,1]
plot = ElasticNet(alpha)
plot.show()
```

```
100%|██████████████████████████████████████████| 15/15
[02:38<00:00,  3.67s/it]
```



In [62]:

```
linear_clf = ElasticNet(alpha=.9, fit_intercept=True, normalize=False, max_iter=100,\
                        random_state=23)
linear_clf.fit(scaled_train,actual_y)
r_square = r2_score(actual_y,linear_clf.predict(scaled_train))
RMSE = mean_squared_error(actual_y,linear_clf.predict(scaled_train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")

# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = linear_clf.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

```
R_square for train data is : 0.5854756246242212
RMSE for train data is : 7.707962680757946
```

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process: ElasticNet regression is also performing well, WE can take .9 as alpha value

<!DOCTYPE html>

MODEL SUMMARY

SNO	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776

5.1.4 Linear Regression with LARSLasso

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process: This is something new, This model internaly do the feature engineering itself while moving the coefficient in the direction of the residual of higly correlated feature. <img src = "https://miro.medium.com/max/1400/1*M-g5bn8rs04qfvdfULc_jw.png" width="700" height="400"> </img> <img src = "https://slideplayer.com/slide/14868887/90/images/3/Computation+of+the+lasso+solution.jpg" width="300" height="400"></img>

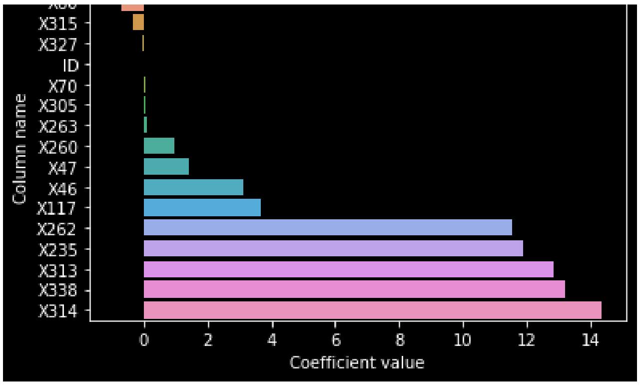
In [64]:

```
#https://www.quora.com/What-is-Least-Angle-Regression-and-when-should-it-be-used
# not much hyperparametertuning involved in it.

LassoLars = LassoLarsCV(normalize=True,cv=5)
LassoLars.fit(scaled_train,actual_y)
r_square = r2_score(actual_y,LassoLars.predict(scaled_train))
RMSE = mean_squared_error(actual_y,LassoLars.predict(scaled_train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")
```

```
R_square for train data is : 0.5994843231600018
RMSE for train data is : 7.576599419537981
```

In [0]:

```
coef_ = [i for i in sorted(zip(Lasso_model.coef_,train.columns), key = lambda x : x[0]) if i[0]!=0.0
]
sns.barplot([i[0] for i in coef_], [i[1] for i in coef_])
plt.title("LarsLasso Coefficints importance")
plt.xlabel("Coefficient value")
plt.ylabel("Column name")
plt.show()
```



In [65]:

```
# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = LassoLars.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
LassoLars = LassoLarsCV(normalize=True,cv=5)
LassoLars.fit(scaled_train,actual_y)
r_square = r2_score(actual_y,LassoLars.predict(scaled_train))
RMSE = mean_squared_error(actual_y,LassoLars.predict(scaled_train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")
```

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process: LARSLASSO : It is also performing well, We can think pof taking LassoLars as our final stacking model because we are getting high R^2 both of these models but in ridge model we are getting high r^2 but testing score is not good..

<!DOCTYPE html>

MODEL SUMMARY

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523

5.1.5 Decision tree

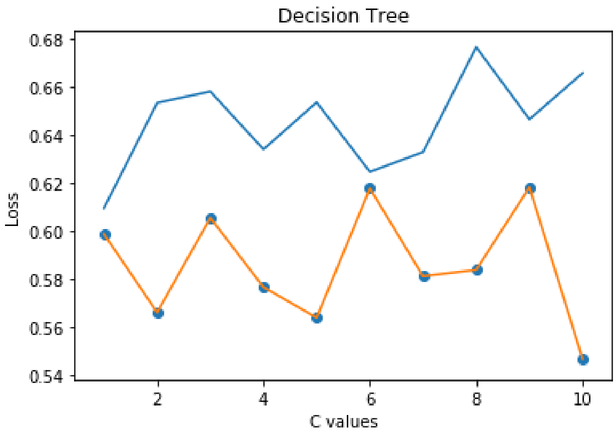
In [35]:

```
from sklearn.tree import DecisionTreeRegressor
a = decision_tree()
plt = a[0]
Decsion_clf = a[1]
```

```
Fitting 10 folds for each of 10 candidates, totalling 100 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  25 tasks      | elapsed:   51.8s
[Parallel(n_jobs=-1)]: Done 100 out of 100 | elapsed:  2.5min finished
```

```
params no 0 : {'min_samples_split': 9, 'max_leaf_nodes': 15, 'max_depth': 10, 'criterion': 'mae'}
test score : [0.5986097311283262]
params no 1 : {'min_samples_split': 7, 'max_leaf_nodes': 500, 'max_depth': 9, 'criterion': 'mae'}
test score : [0.5986097311283262, 0.5659282479808944]
params no 2 : {'min_samples_split': 2, 'max_leaf_nodes': 30, 'max_depth': 9, 'criterion':
'friedman_mse'} test score : [0.5986097311283262, 0.5659282479808944, 0.6053896096621396]
params no 3 : {'min_samples_split': 5, 'max_leaf_nodes': 300, 'max_depth': 7, 'criterion': 'mae'}
test score : [0.5986097311283262, 0.5659282479808944, 0.6053896096621396, 0.5764651899327132]
params no 4 : {'min_samples_split': 4, 'max_leaf_nodes': 100, 'max_depth': 9, 'criterion': 'mae'}
test score : [0.5986097311283262, 0.5659282479808944, 0.6053896096621396, 0.5764651899327132, 0.56
3731574349027]
params no 5 : {'min_samples_split': 5, 'max_leaf_nodes': 50, 'max_depth': 3, 'criterion':
'friedman_mse'} test score : [0.5986097311283262, 0.5659282479808944, 0.6053896096621396,
0.5764651899327132, 0.563731574349027, 0.6176673994770719]
params no 6 : {'min_samples_split': 2, 'max_leaf_nodes': 45, 'max_depth': 8, 'criterion': 'mae'} t
est score : [0.5986097311283262, 0.5659282479808944, 0.6053896096621396, 0.5764651899327132,
0.563731574349027, 0.6176673994770719, 0.5810694349328146]
params no 7 : {'min_samples_split': 4, 'max_leaf_nodes': 300, 'max_depth': 8, 'criterion': 'mse'}
test score : [0.5986097311283262, 0.5659282479808944, 0.6053896096621396, 0.5764651899327132, 0.56
3731574349027, 0.6176673994770719, 0.5810694349328146, 0.5836624116796425]
params no 8 : {'min_samples_split': 3, 'max_leaf_nodes': 1000, 'max_depth': 5, 'criterion': 'mse'}
test score : [0.5986097311283262, 0.5659282479808944, 0.6053896096621396, 0.5764651899327132, 0.56
3731574349027, 0.6176673994770719, 0.5810694349328146, 0.5836624116796425, 0.6181506795869838]
params no 9 : {'min_samples_split': 5, 'max_leaf_nodes': 1000, 'max_depth': 10, 'criterion':
'mae'} test score : [0.5986097311283262, 0.5659282479808944, 0.6053896096621396,
0.5764651899327132, 0.563731574349027, 0.6176673994770719, 0.5810694349328146, 0.5836624116796425,
0.6181506795869838, 0.5466245593622039]
```



In [41]:

```python
print("Our best score is : ",Decsion_clf.best_score_)
print("Our best estimator : ",Decsion_clf.best_estimator_)
```

```
Our best score is :  0.6181506795869838
Our best estimator :  DecisionTreeRegressor(ccp_alpha=0.0, criterion='mse', max_depth=5,
                      max_features=None, max_leaf_nodes=1000,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=3,
                      min_weight_fraction_leaf=0.0, presort='deprecated',
                      random_state=2, splitter='best')
```

In [66]:

```python
DECISONTREE = DecisionTreeRegressor(ccp_alpha=0.0, criterion='mse', max_depth=5,
                      max_features=None, max_leaf_nodes=1000,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=3,
                      min_weight_fraction_leaf=0.0, presort='deprecated',
                      random_state=2, splitter='best')
DECISONTREE.fit(scaled_train,actual_y)
r_square = r2_score(actual_y,DECISONTREE.predict(scaled_train))
```

```
RMSE = mean_squared_error(actual_y,DECISONTREE.predict(scaled_train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")
```

```
R_square for train data is : 0.6454119630355636
RMSE for train data is : 7.128967029819329
```

In [67]:

```
# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = DECISONTREE.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process: I can see decision regression tree model is also working well, I can also think of taking it in stacking model.

<!DOCTYPE html>

MODEL SUMMARY

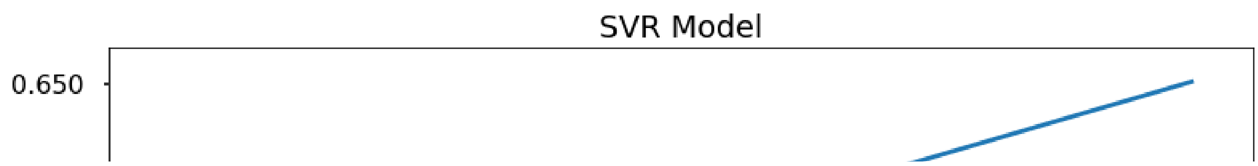
SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772

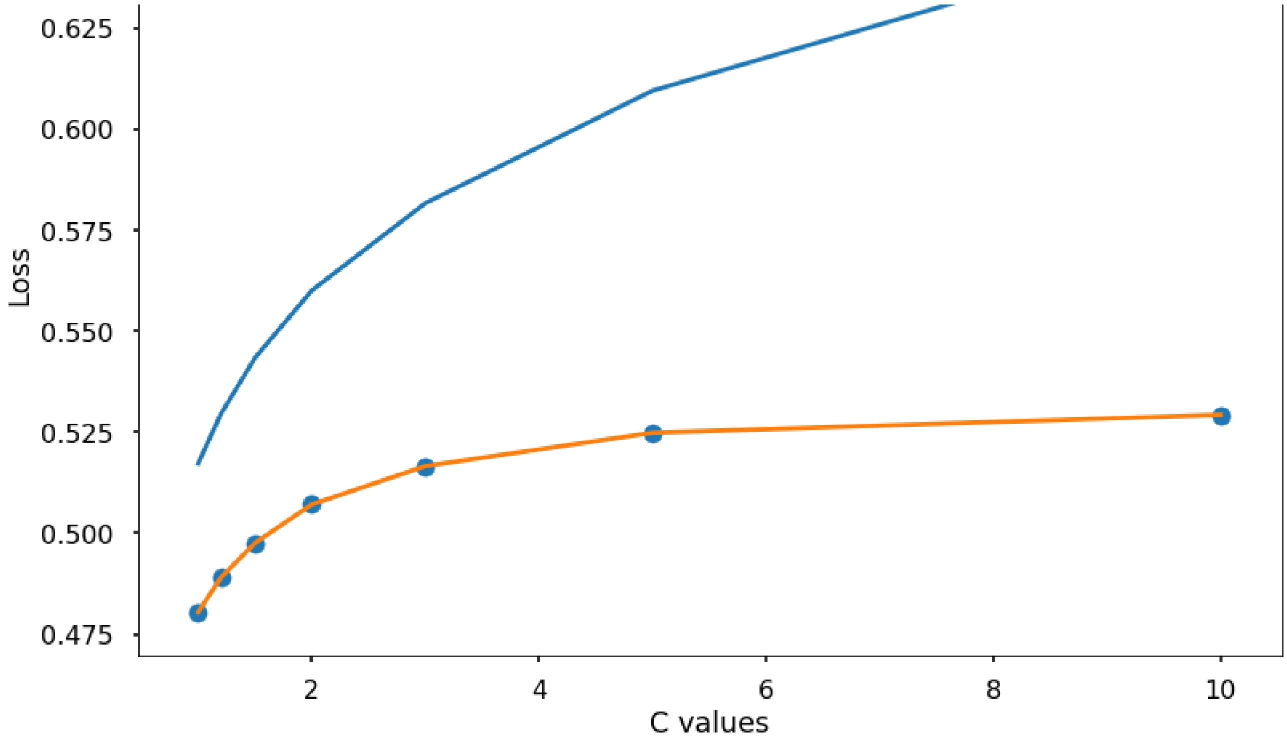
5.1.5 SVR

In [12]:

```
C_values = [1,1.2,1.5,2,3,5,10]
plt = SVR_Regression(scaled_train,C_values)
plt.show()
```

```
[LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM]
[LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM]
[LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM]
[LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM]
```





In [15]:

```
SVR_MODEL = SVR(kernel='rbf', degree=3, gamma='scale', C = 1, epsilon=0.2,\
        verbose=3, max_iter=-1)
SVR_MODEL_FIT(SVR_MODEL)
```

```
[LibSVM]R_square for train data is : 0.5254812433223481
RMSE for train data is : 8.246910063686485
Submission_Final.csv Generated
```

<!DOCTYPE html>

MODEL SUMMARY

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No

5.1.6 XGBOOST

In [ ]:

```
'''Cross validation the xgb model then predict the test data'''

max_depths = [3,4]
n_treess = [100,400,520]
etas = [.001,.0045]
subsamples = [.93,.95]
count = 0
dtrain = xgb.DMatrix(decomposed_train, actual_y)
dtest = xgb.DMatrix(decomposed_test)

# GRID SEARCH
for max_depth in max_depths:
    for n_trees in n_treess:
        for eta in etas:
            for subsample in subsamples:
                xgb_params = {
                            'n_trees': n_trees,
                            'max_depth': max_depth,
                            'eta': eta,
                            'subsample': subsample,
                            'objective': 'reg:linear',
                            'eval_metric': 'rmse',
                        }
                print(f"Parameters are :{max_depth,n_trees,eta,subsample}")
                print(f"Total iteration :{len(max_depths)*len(n_treess)*len(etas)*len(subsamples)}'
)
                print(f"Total iteration remaining :
{len(max_depths)*len(n_treess)*len(etas)*len(subsamples) - (count)}")
                print("#"*110)
                count+=1
                # NOTE: Make sure that the class is labeled 'class' in the data file
                num_boost_rounds = 1700
                XGBOOST_CV = xgb.cv(xgb_params, dtrain, nfold=5,
verbose_eval=3,early_stopping_rounds=5, num_boost_round=num_boost_rounds)
                print("#"*110)
```

```
Parameters are :(3, 100, 0.001, 0.93)
Total iteration :24
Total iteration remaining :24
##############################################################################################################
[00:08:53] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[00:08:53] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[00:08:54] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[00:08:54] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[00:08:54] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[0] train-rmse:100.555+0.138825 test-rmse:100.554+0.555034
[3] train-rmse:100.256+0.138387 test-rmse:100.254+0.553452
[6] train-rmse:99.9576+0.137981 test-rmse:99.9561+0.551843
[9] train-rmse:99.6601+0.137617 test-rmse:99.6587+0.550195
[12] train-rmse:99.3636+0.137223 test-rmse:99.3621+0.548583
[15] train-rmse:99.0679+0.136803 test-rmse:99.0664+0.547011
[18] train-rmse:98.7731+0.136389 test-rmse:98.7716+0.545434
[21] train-rmse:98.4792+0.135942 test-rmse:98.4777+0.543899
[24] train-rmse:98.1862+0.135485 test-rmse:98.1848+0.542372
[27] train-rmse:97.894+0.135091 test-rmse:97.8926+0.54079
[30] train-rmse:97.6028+0.13471 test-rmse:97.6014+0.539211
```

In [8]:

```
'''Train the xgb model then predict the test data'''
```

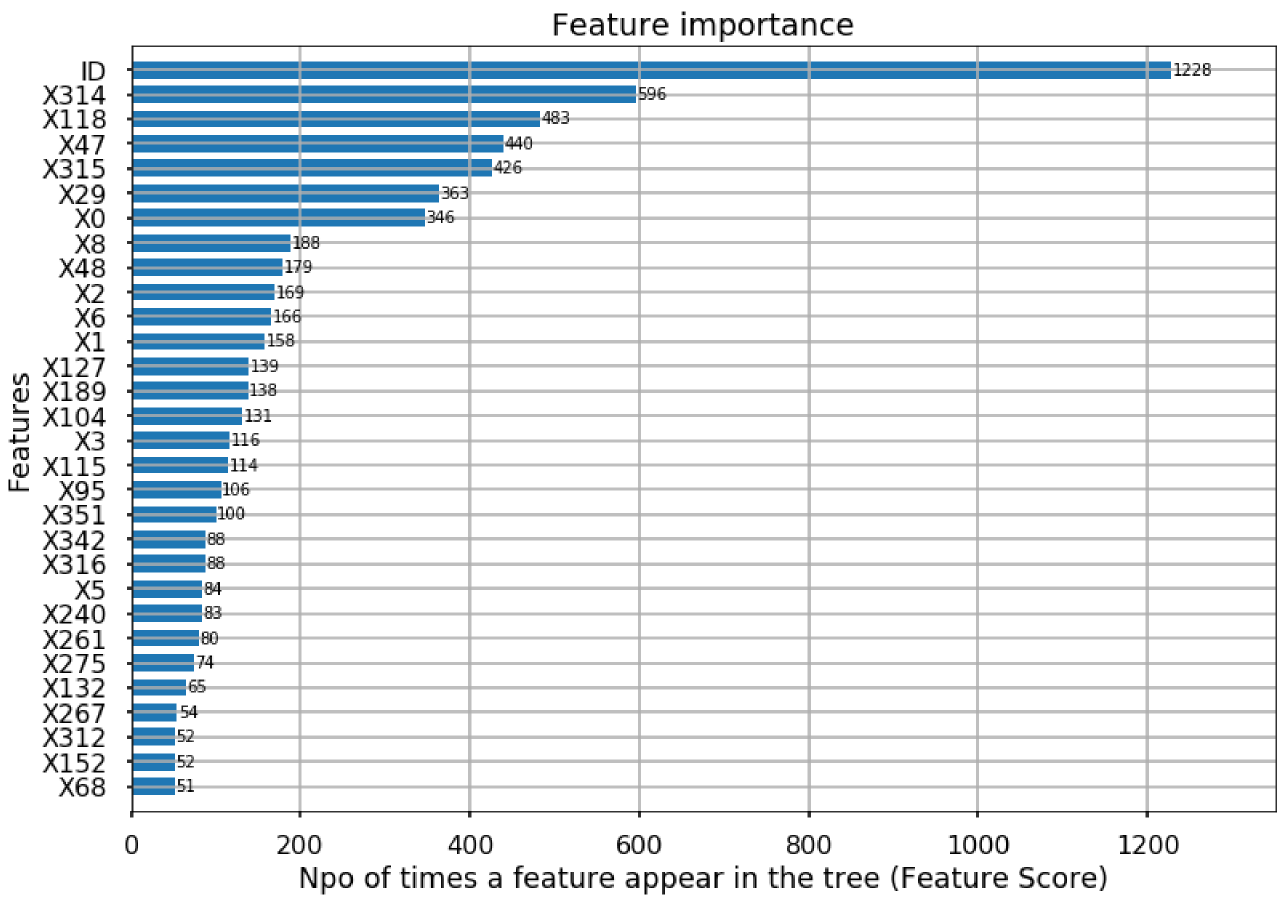
```
# (3, 100, 0.0045, 0.93)
# max_depth,n_trees,eta,subsample
xgb_params = {
    'n_trees': 100,
    'eta': 0.0045,
    'max_depth': 3,
    'subsample': 0.93,
    'objective': 'reg:linear',
    'eval_metric': 'rmse',
    'silent': 1
}



dtrain = xgb.DMatrix(scaled_train, actual_y)
dtest = xgb.DMatrix(scaled_test)

# NOTE: Make sure that the class is labeled 'class' in the data file
num_boost_rounds = 1290
# train model
model = xgb.train(dict(xgb_params, silent=0), dtrain, num_boost_round=num_boost_rounds)
y_pred_train = model.predict(dtrain)
y_pred = model.predict(dtest)
print(f"(r2  : {r2_score(actual_y,y_pred_train)} and mean_squared_error
{mean_squared_error(actual_y,y_pred_train,squared=False)})  ")
```

```
[00:13:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
(r2  : 0.6517110012489504 and mean_squared_error 7.06536243437644)
```

In [9]:

```
plt.style.use('seaborn-poster')
plt.figure(figsize=(16,8))
xgb.plot_importance(model,max_num_features=30,height=.7,xlabel = "Npo of times a feature appear in
the tree (Feature Score)")
plt.show()
```

```
<Figure size 1152x576 with 0 Axes>
```



In [10]:

```
# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = model.predict(dtest)
sub.to_csv('submission_Final.csv', index=False)
```

<!DOCTYPE html>

MODEL SUMMARY

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
6.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.65	7.06	.54901

GBDT Regressor

In [40]:

```
GBDT_Regression(scaled_train,scaled_test)
```

```
Fitting 5 folds for each of 20 candidates, totalling 100 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  25 tasks      | elapsed:    9.4s
[Parallel(n_jobs=-1)]: Done 100 out of 100 | elapsed:   30.6s finished
```

```
params : {'subsample': 0.2, 'min_samples_split': 6, 'min_samples_leaf': 4, 'max_features': 0.55,
'max_depth': 9, 'learning_rate': 0.001} and it's test r2 score is 0.10614689742709563 and it's tra
in r2 score is 0.11791930230271944
params : {'subsample': 0.6, 'min_samples_split': 8, 'min_samples_leaf': 10, 'max_features': 0.55,
'max_depth': 4, 'learning_rate': 0.0025} and it's test r2 score is 0.23818994586839998 and it's tr
ain r2 score is 0.24797759475997339
params : {'subsample': 0.1, 'min_samples_split': 7, 'min_samples_leaf': 5, 'max_features': 0.7,
'max_depth': 7, 'learning_rate': 0.02} and it's test r2 score is 0.5944674140723427 and it's train
r2 score is 0.64262664575852
params : {'subsample': 0.2, 'min_samples_split': 4, 'min_samples_leaf': 6, 'max_features': 0.4,
'max_depth': 3, 'learning_rate': 0.0025} and it's test r2 score is 0.22961647159553555 and it's tr
ain r2 score is 0.23641057639126042
params : {'subsample': 0.5, 'min_samples_split': 2, 'min_samples_leaf': 4, 'max_features': 0.5,
```

```
'max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is 0.10819641132364985 and it's tra
in r2 score is 0.11988152822742941
params : {'subsample': 0.2, 'min_samples_split': 2, 'min_samples_leaf': 3, 'max_features': 0.9,
'max_depth': 4, 'learning_rate': 0.001} and it's test r2 score is 0.10776519476249244 and it's tra
in r2 score is 0.1143453113225636
params : {'subsample': 0.6, 'min_samples_split': 4, 'min_samples_leaf': 5, 'max_features': 0.4,
'max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is 0.10763129729247241 and it's tra
in r2 score is 0.11941141792845485
params : {'subsample': 0.4, 'min_samples_split': 7, 'min_samples_leaf': 9, 'max_features': 0.9,
'max_depth': 2, 'learning_rate': 0.0045} and it's test r2 score is 0.3289003025577405 and it's tra
in r2 score is 0.33366855906576226
params : {'subsample': 0.4, 'min_samples_split': 10, 'min_samples_leaf': 7, 'max_features': 0.3, '
max_depth': 7, 'learning_rate': 0.001} and it's test r2 score is 0.10641798932327684 and it's trai
n r2 score is 0.11589038902059183
params : {'subsample': 0.4, 'min_samples_split': 2, 'min_samples_leaf': 10, 'max_features': 0.4, '
max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is 0.10709494103014786 and it's trai
n r2 score is 0.11701060432633029
params : {'subsample': 0.4, 'min_samples_split': 4, 'min_samples_leaf': 15, 'max_features': 0.3, '
max_depth': 8, 'learning_rate': 0.0045} and it's test r2 score is 0.36433288617530046 and it's tra
in r2 score is 0.38135825682793756
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 6, 'max_features': 0.7,
'max_depth': 2, 'learning_rate': 0.0045} and it's test r2 score is 0.327350152395288 and it's trai
n r2 score is 0.3326010208652506
params : {'subsample': 0.1, 'min_samples_split': 9, 'min_samples_leaf': 9, 'max_features': 0.5,
'max_depth': 5, 'learning_rate': 0.0045} and it's test r2 score is 0.3513818057066332 and it's tra
in r2 score is 0.3641637984664583
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 10, 'max_features': 0.4, '
max_depth': 3, 'learning_rate': 0.0045} and it's test r2 score is 0.3521208531890345 and it's
train r2 score is 0.35982088193995554
params : {'subsample': 0.5, 'min_samples_split': 3, 'min_samples_leaf': 20, 'max_features': 0.55,
'max_depth': 4, 'learning_rate': 0.001} and it's test r2 score is 0.1062775797785166 and it's trai
n r2 score is 0.11358244671427997
params : {'subsample': 0.5, 'min_samples_split': 8, 'min_samples_leaf': 3, 'max_features': 0.55,
'max_depth': 7, 'learning_rate': 0.007} and it's test r2 score is 0.4658133460361363 and it's trai
n r2 score is 0.5035721283330067
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 4, 'max_features': 0.5,
'max_depth': 2, 'learning_rate': 0.0045} and it's test r2 score is 0.32232127951459033 and it's tr
ain r2 score is 0.32767743127570836
params : {'subsample': 0.4, 'min_samples_split': 8, 'min_samples_leaf': 15, 'max_features': 0.4, '
max_depth': 2, 'learning_rate': 0.02} and it's test r2 score is 0.5815364253015239 and it's train
r2 score is 0.5887210636873584
params : {'subsample': 0.2, 'min_samples_split': 7, 'min_samples_leaf': 3, 'max_features': 0.7,
'max_depth': 7, 'learning_rate': 0.02} and it's test r2 score is 0.5840562174248403 and it's train
r2 score is 0.6697645140009827
params : {'subsample': 0.2, 'min_samples_split': 8, 'min_samples_leaf': 10, 'max_features': 0.5, '
max_depth': 7, 'learning_rate': 0.001} and it's test r2 score is 0.10570511226464671 and it's trai
n r2 score is 0.11491147418411371
Best score: 0.5944674140723427
Best params:
learning_rate: 0.02
max_depth: 7
max_features: 0.7
min_samples_leaf: 5
min_samples_split: 7
subsample: 0.1
GBDT best model result : 0.6363793413232426
```

<!DOCTYPE html>

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1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH	ALPHA = .9	0.58	7.70	0.51776

			100				
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
6.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.65	7.06	.54901
7.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.54901

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

My Thought Process From this i can see the most important features are catagorical features as i can see in the feature importance fgeatures above and wow!!! ID is playing a very good roll i in predicting y.

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

Attempt 2.

My Thought Process: I want to select that model which on hyperparameter tuning gets as closed result on test data also so that, our model will not behave badly on test data i.e Train loss as close as possible with test loss.

NOTE : Now eveything in blue is used in the subsequent model, we will check one by one all our analsys and will see the performance for eg: below we are using onnly 1.1 and 2.2 in the model

1. Y imputation

1.1 Removing above than 150 sec in Y values with mean of train['y'] i.e. 100 approx.

1.2 Removing 12 unimportant features from the dataset and check what happend in the performa nce, i will check only with one model for checking purpose

1.3 Removing only 265.32 y values with mean of train['y] i.e 100 approx.

1.4 Removing only 265.32 y values with somwe other values other than 100 approx

2. Feature engineering

2.1 For catagorical values use label encoding

2.2 For catagorical values use one hot encoding encoding

2.3 Remove ID and use best of the above encoding and see the performance, as ID as per the business problem may have some hidden sequencing information or may be not, we have to see.

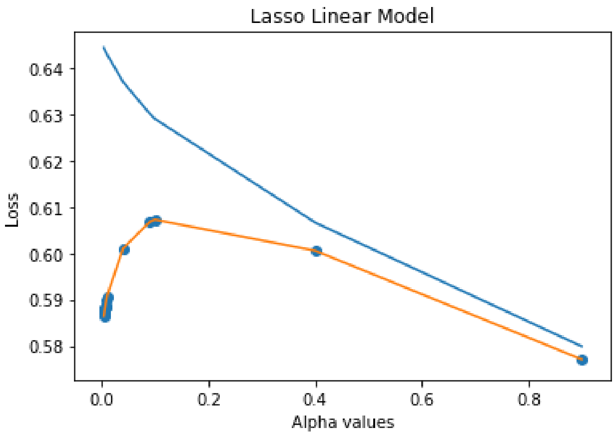
2.4 I will fetch the best features by using all well known feture decompostiiton algorithm.

5.1.1 Linear Regression with ridge

In [29]:

```
plot = Lasso_regression([.004,.005,.006,.0062,.0065,.0067,.0069,.007,.009,.01,.04,.09,.1,.4,.9])
plot.show()
```

```
100%|██████████████████████████████████████████████████| 15/15
[03:05<00:00,  7.44s/it]
```



<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGI2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process: I am selecting .9 as tuned alpha value here.

In [30]:

```python
linear_clf = Lasso(alpha=.9, fit_intercept=True, normalize=False,random_state=23)
linear_clf.fit(scaled_train,actual_y)
r_square = r2_score(actual_y,linear_clf.predict(scaled_train))
RMSE = mean_squared_error(actual_y,linear_clf.predict(scaled_train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")

# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = linear_clf.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

```
R_square for train data is : 0.579687053379915
RMSE for train data is : 7.761594512905049
```

<!DOCTYPE html>

MODEL SUMMARY

ATTEMPT 1

SNO	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772

			100				
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
6.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Mupliple parameters	.65	7.01	.54901
7.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.54901

ATTEMPT 2

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
6.	LASSO REGRESSION MODEL	LABEL ENCODING	REMOVED 12 UNIMPORTANT FEATURES FROM THE DATASET	ALPHA = .9	0.58	7.761	0.51926

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process: I am getting the same result as above with this one also, As i am jst removing the unimportant features so no reduction in the model performance which make sense so skipping this thing it's will be wastage of time and resource.

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

Attempt 3.

My Thought Process: I want to select that model which on hyperparameter tuning gets as closed result on test data also so that, our model will not behave badly on test data i.e Train loss as close as possible with test loss.

NOTE : Now eveything in blue is used in the subsequent model, we will check one by one all our analsys and will see the performance for eg: below we are using onnly 1.1 and 2.2 in the model

1. Y imputation

    1.1 Removing above than 150 sec in Y values with mean of train['y'] i.e. 100 approx.

    1.2 Removing 12 unimportant features from the dataset and check what happend in the
    performance, i will check only with one model for checking purpose

1.3 Removing only 265.32 y values with mean of train['y'] i.e 100 approx.

    1.4 Removing only 265.32 y values with somwe other values other than 100 approx

2. Feature engineering

2.1 For catagorical values use label encoding

    2.2 For catagorical values use one hot encoding encoding

    2.3 Remove ID and use best of the above encoding and see the performance, as ID as per the
    business problem may have some hidden sequencing information or may be not, we have to see.

    2.4 I will fetch the best features by using all well known feture decompostiiton algorithm.

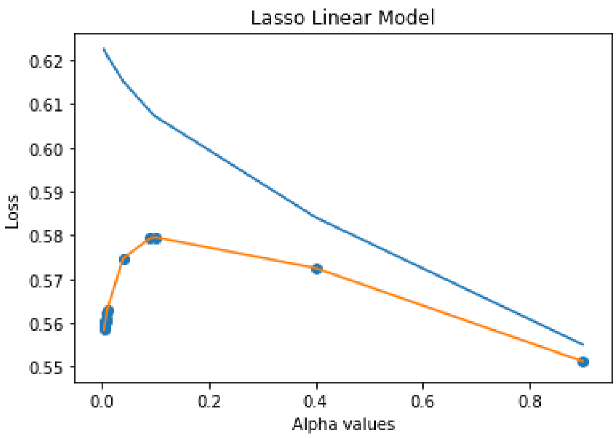
    2.5 Concatenate original features with decomposed features and do the analysis.

In [36]:

```
plot = Lasso_regression([.004,.005,.006,.0062,.0065,.0067,.0069,.007,.009,.01,.04,.09,.1,.4,.9])
plt.show()
```

```
plot.show()
```

```
100%|████████████████████████████████████████████████████████████████| 15/15
[03:06<00:00,  7.61s/it]
```



<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> <u>My Thought Process:</u> I am selecting .9 as tuned alpha value here.

In [37]:

```
linear_clf = Lasso(alpha=.9, fit_intercept=True, normalize=False,random_state=23)
linear_clf.fit(scaled_train,actual_y)
r_square = r2_score(actual_y,linear_clf.predict(scaled_train))
RMSE = mean_squared_error(actual_y,linear_clf.predict(scaled_train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")

# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = linear_clf.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

```
R_square for train data is : 0.5537604212320638
RMSE for train data is : 8.297502419827739
```

<!DOCTYPE html>

MODEL SUMMARY

ATTEMPT 1

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
	DECISIONTREE	LABEL	ABOVE 150 SEC VALUES	Multi-			

5.	DECISIONTREE MODEL	LABEL ENCODING	SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
6.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Mupliple parameters	.65	7.01	.54901
7.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.54901

ATTEMPT 2

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
6.	LASSO REGRESSION MODEL	LABEL ENCODING	REMOVED 12 UNIMPORTANT FEATURES FROM THE DATASET	ALPHA = .9	0.58	7.761	0.51926

ATTEMPT 3

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
6.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .9	0.553	8.29	0.52224

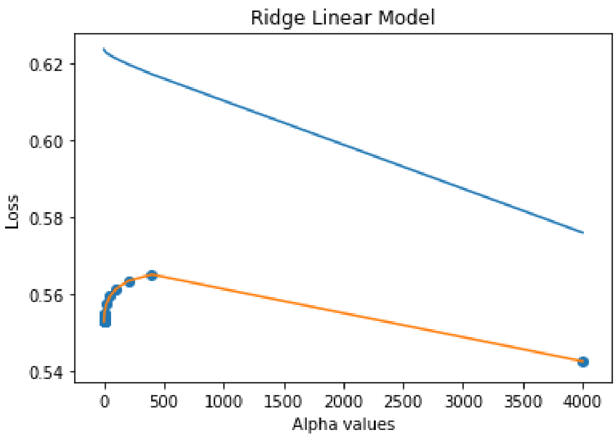
<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process: I am getting increase in the private and public score pg kaggle compared to the previous lasso score so, imputing only 265.32 is good strategy

5.1.2 Linear Regression with Ridge

In [41]:

```
alpha = [.000001,.00001,.007,.07,.09,.1,.2,.5,.7,.9,1,2,3,4,20,50,100,200,400,4000]
plot = Ridge_regression(alpha)
plot.show()
```

```
100%|████████████████████████████████████████████████████████████| 20/20
[00:11<00:00,  1.78it/s]
```



In [40]:

```
linear_clf = Ridge(alpha=400, fit_intercept=True, normalize=True, max_iter=100,\
                   random_state=23)
linear_clf.fit(train,actual_y)
r_square = r2_score(actual_y,linear_clf.predict(train))
RMSE = mean_squared_error(actual_y,linear_clf.predict(train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")

# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = linear_clf.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

```
R_square for train data is : 0.0315044438836457O5
RMSE for train data is : 12.223966763843501
```

<!DOCTYPE html>

MODEL SUMMARY

ATTEMPT 1

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
6.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Mupliple parameters	.65	7.01	.54901
7.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.54901

ATTEMPT 2

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
6.	LASSO REGRESSION MODEL	LABEL ENCODING	REMOVED 12 UNIMPORTANT FEATURES FROM THE DATASET	ALPHA = .9	0.58	7.761	0.51926

ATTEMPT 3

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE

SNo	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	PRIVATE SCORE
6.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .9	0.553	8.29	0.52224
6.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = 400	0.031	12.22	0.12

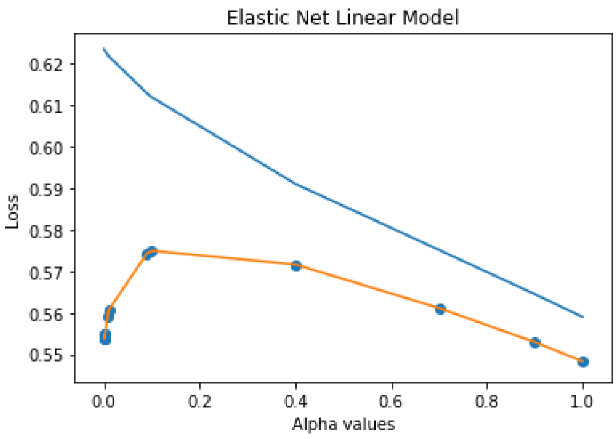
5.1.3 Linear Regression with Elsatic net

In [64]:

```
alpha = [.0000001,.00001,.0001,.0003,.0005,.0008,.001,.008,.01,.09,.1,.4,.7,.9,1]
plot = Elastic_Net(alpha)
plot.show()
```

```
  0%|                                                                        | 0
[00:00<?, ?it/s]

  7%|█████                                                          | 1/15 [00:
05:40, 24.31s/it]

 13%|██████████                                                     | 2/15 [00:
05:24, 25.00s/it]

 20%|███████████████                                                | 3/15
[01:17<05:04, 25.39s/it]

 27%|████████████████████                                           | 4/15 [01:
<04:41, 25.63s/it]

 33%|█████████████████████████                                      | 5/15 [02:
<04:16, 25.62s/it]

 40%|██████████████████████████████                                 | 6/15
[02:34<03:49, 25.49s/it]
```

```
 47%|██████████████████████████████████████                                            | 7/15
[02:59<03:23, 25.44s/it]
 53%|████████████████████████████████████████████                                      | 8/15 [03:
3<02:55, 25.01s/it]
 60%|█████████████████████████████████████████████████                                 | 9/15 [03:
7<02:27, 24.61s/it]
 67%|██████████████████████████████████████████████████████                           | 10/15
[03:57<01:41, 20.32s/it]
 73%|████████████████████████████████████████████████████████████                     | 11/15 [04:
06<01:08, 17.05s/it]
 80%|█████████████████████████████████████████████████████████████████                | 12/15 [04:
10<00:38, 12.94s/it]
 87%|███████████████████████████████████████████████████████████████████████          | 13/15 [04:
12<00:19,  9.75s/it]
 93%|████████████████████████████████████████████████████████████████████████████     | 14/15
[04:14<00:07,  7.40s/it]
100%|█████████████████████████████████████████████████████████████████████████████████| 15/15
[04:16<00:00,  5.74s/it]
```



<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

<u>My Thought Process</u> : From the graph i can take .7 as my hypertuned alpha

In [66]:

```
linear_clf = ElasticNet(alpha=.7, fit_intercept=True, normalize=False, max_iter=100,\
                        random_state=23)
linear_clf.fit(scaled_train,actual_y)
r_square = r2_score(actual_y,linear_clf.predict(scaled_train))
RMSE = mean_squared_error(actual_y,linear_clf.predict(scaled_train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")

# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = linear_clf.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

```
R_square for train data is : 0.5738562824177406
RMSE for train data is : 8.108516212179207
```

<!DOCTYPE html>

MODEL SUMMARY

ATTEMPT 1

SNO	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772

6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
6.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Mupliple parameters	.65	7.01	.54901
7.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.54901

ATTEMPT 2

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
6.	LASSO REGRESSION MODEL	LABEL ENCODING	REMOVED 12 UNIMPORTANT FEATURES FROM THE DATASET	ALPHA = .9	0.58	7.761	0.51926

ATTEMPT 3

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
6.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .9	0.553	8.29	0.52224
6.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = 400	0.031	12.22	0.12
7.	ELASTICNET REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .7	0.573	8.10	.52685

5.1.4 Linear Regression with LARSLasso

In [67]:

```
#https://www.quora.com/What-is-Least-Angle-Regression-and-when-should-it-be-used
# not much hyperparametertuning involved in it.

LassoLars = LassoLarsCV(normalize=True,cv=5)
LassoLars.fit(scaled_train,actual_y)
r_square = r2_score(actual_y,LassoLars.predict(scaled_train))
RMSE = mean_squared_error(actual_y,LassoLars.predict(scaled_train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")
```

```
R_square for train data is : 0.5550822084993573
RMSE for train data is : 8.285204466847453
```

In [69]:

```
# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = LassoLars.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

<!DOCTYPE html>

MODEL SUMMARY

ATTEMPT 1

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
6.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Mupliple parameters	.65	7.01	.54901
7.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.54901

ATTEMPT 2

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
6.	LASSO REGRESSION MODEL	LABEL ENCODING	REMOVED 12 UNIMPORTANT FEATURES FROM THE DATASET	ALPHA = .9	0.58	7.761	0.51926

ATTEMPT 3

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
6.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .9	0.553	8.29	0.52224
6.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = 400	0.031	12.22	0.12
7.	ELASTICNET REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .7	0.573	8.10	.52685
7.	LASSOLARS MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	NORMALIZE = TRUE	0.555	8.28	.5173

5.1.5 Decision tree

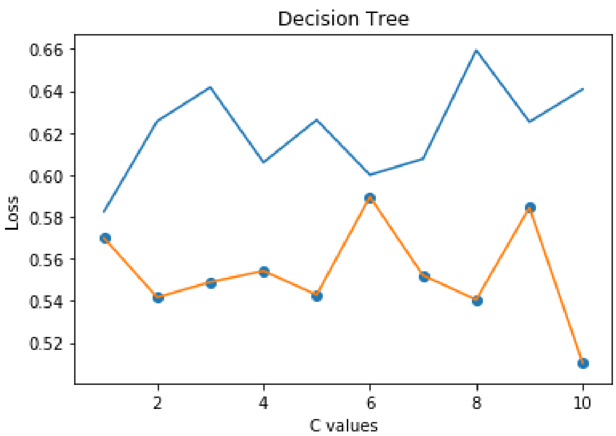
In [70]:

```
a = decision_tree()
plt = a[0]
Decsion_clf = a[1]
plt.show()
```

```
Fitting 10 folds for each of 10 candidates, totalling 100 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  25 tasks      | elapsed:   56.4s
[Parallel(n_jobs=-1)]: Done 100 out of 100 | elapsed:  2.8min finished
```

```
params no 0 : {'min_samples_split': 9, 'max_leaf_nodes': 15, 'max_depth': 10, 'criterion': 'mae'}
test score : [0.5699317033370882]
params no 1 : {'min_samples_split': 7, 'max_leaf_nodes': 500, 'max_depth': 9, 'criterion': 'mae'}
test score : [0.5699317033370882, 0.541676668620916]
params no 2 : {'min_samples_split': 2, 'max_leaf_nodes': 30, 'max_depth': 9, 'criterion':
'friedman_mse'} test score : [0.5699317033370882, 0.541676668620916, 0.548936293144281]
params no 3 : {'min_samples_split': 5, 'max_leaf_nodes': 300, 'max_depth': 7, 'criterion': 'mae'}
test score : [0.5699317033370882, 0.541676668620916, 0.548936293144281, 0.5542429055373415]
params no 4 : {'min_samples_split': 4, 'max_leaf_nodes': 100, 'max_depth': 9, 'criterion': 'mae'}
test score : [0.5699317033370882, 0.541676668620916, 0.548936293144281, 0.5542429055373415,
0.5428732683048892]
params no 5 : {'min_samples_split': 5, 'max_leaf_nodes': 50, 'max_depth': 3, 'criterion':
'friedman_mse'} test score : [0.5699317033370882, 0.541676668620916, 0.548936293144281,
0.5542429055373415, 0.5428732683048892, 0.5895548763478131]
params no 6 : {'min_samples_split': 2, 'max_leaf_nodes': 45, 'max_depth': 8, 'criterion': 'mae'} t
est score : [0.5699317033370882, 0.541676668620916, 0.548936293144281, 0.5542429055373415,
0.5428732683048892, 0.5895548763478131, 0.5521145147357831]
params no 7 : {'min_samples_split': 4, 'max_leaf_nodes': 300, 'max_depth': 8, 'criterion': 'mse'}
test score : [0.5699317033370882, 0.541676668620916, 0.548936293144281, 0.5542429055373415,
0.5428732683048892, 0.5895548763478131, 0.5521145147357831, 0.5405552350784676]
params no 8 : {'min_samples_split': 3, 'max_leaf_nodes': 1000, 'max_depth': 5, 'criterion': 'mse'}
test score : [0.5699317033370882, 0.541676668620916, 0.548936293144281, 0.5542429055373415,
0.5428732683048892, 0.5895548763478131, 0.5521145147357831, 0.5405552350784676,
0.5844303458967558]
params no 9 : {'min_samples_split': 5, 'max_leaf_nodes': 1000, 'max_depth': 10, 'criterion':
'mae'} test score : [0.5699317033370882, 0.541676668620916, 0.548936293144281, 0.5542429055373415,
0.5428732683048892, 0.5895548763478131, 0.5521145147357831, 0.5405552350784676,
0.5844303458967558, 0.5105804610270998]
```



In [72]:

```
print("Our best score is : ",Decsion_clf.best_score_)
print("Our best estimator : ",Decsion_clf.best_estimator_)

 #lET'S FIND THE KAGGLE SCORE.
DECISONTREE = Decsion_clf.best_estimator_
decision_classfier = best_decison_tree(DECISONTREE)
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = decision_classfier.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

```
R_square for train data is : 0.5994855038960254
RMSE for train data is : 7.860903482514222
```

<!DOCTYPE html>

MODEL SUMMARY

ATTEMPT 1

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
7.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Mupliple parameters	.65	7.01	.54901
7.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.54901

ATTEMPT 2

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
8.	LASSO REGRESSION MODEL	LABEL ENCODING	REMOVED 12 UNIMPORTANT FEATURES FROM THE DATASET	ALPHA = .9	0.58	7.761	0.51926

ATTEMPT 3

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
9.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .9	0.553	8.29	0.52224
10.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = 400	0.031	12.22	0.12
11.	ELASTICNET REGRESSOR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .7	0.573	8.10	.52685
12.	LASSOLARS MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	NORMALIZE = TRUE	0.555	8.28	.5173
13.	DECISIONTREE REGRESSOR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	0.60	7.86	.54353

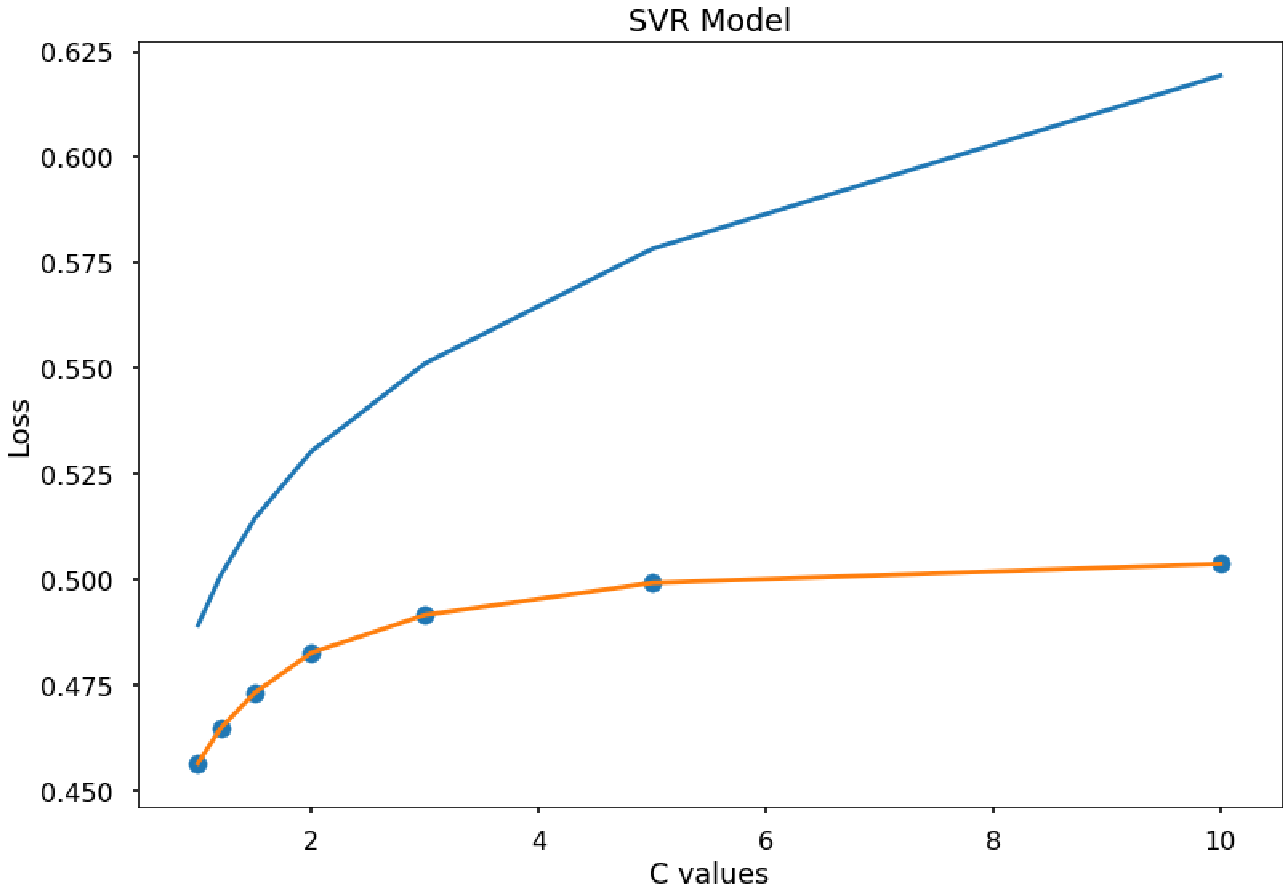
5.1.5 SVR Model

5.1.5 SVR Model

In [23]:

```
C_values = [1,1.2,1.5,2,3,5,10]
plt = SVR_Regression(scaled_train,C_values)
plt.show()
```

```
[LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM]
[LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM]
[LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM]
[LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM] [LibSVM]
```



In [24]:

```
SVR_MODEL = SVR(kernel='rbf', degree=3, gamma='scale', C = 1, epsilon=0.2,\
        verbose=3, max_iter=-1)
SVR_MODEL_FIT(SVR_MODEL)
```

```
[LibSVM]R_square for train data is : 0.49741886544890124
RMSE for train data is : 8.805751703343692
Submission_Final.csv Generated
```

5.1.6 XGBOOST

In [ ]:

```
'''Cross validation the xgb model then predict the test data'''

max_depths = [3,4]
n_treess = [100,400,520]
etas = [.001,.0045]
subsamples = [.93,.95]
count = 0
dtrain = xgb.DMatrix(decomposed_train, actual_y)
dtest = xgb.DMatrix(decomposed_test)

# GRID SEARCH
```

```
for max_depth in max_depths:
    for n_trees in n_treess:
        for eta in etas:
            for subsample in subsamples:
                xgb_params = {
                            'n_trees': n_trees,
                            'max_depth': max_depth,
                            'eta': eta,
                            'subsample': subsample,
                            'objective': 'reg:linear',
                            'eval_metric': 'rmse',
                        }
                print(f"Parameters are :{max_depth,n_trees,eta,subsample}")
                print(f"Total iteration :{len(max_depths)*len(n_treess)*len(etas)*len(subsamples)}'
)
                print(f"Total iteration remaining :
{len(max_depths)*len(n_treess)*len(etas)*len(subsamples) - (count)}")
                print("#"*110)
                count+=1
                # NOTE: Make sure that the class is labeled 'class' in the data file
                num_boost_rounds = 1700
                XGBOOST_CV = xgb.cv(xgb_params, dtrain, nfold=5,
verbose_eval=3,early_stopping_rounds=5, num_boost_round=num_boost_rounds)
                print("#"*110)
```

In [ ]:

```
'''Train the xgb model then predict the test data'''
# (3, 100, 0.0045, 0.93)
# max_depth,n_trees,eta,subsample
xgb_params = {
    'n_trees': 100,
    'eta': 0.0045,
    'max_depth': 3,
    'subsample': 0.93,
    'objective': 'reg:linear',
    'eval_metric': 'rmse',
    'silent': 1
}



dtrain = xgb.DMatrix(scaled_train, actual_y)
dtest = xgb.DMatrix(scaled_test)

# NOTE: Make sure that the class is labeled 'class' in the data file
num_boost_rounds = 1290
# train model
model = xgb.train(dict(xgb_params, silent=0), dtrain, num_boost_round=num_boost_rounds)
y_pred_train = model.predict(dtrain)
y_pred = model.predict(dtest)
print(f"(r2  : {r2_score(actual_y,y_pred_train)} and mean_squared_error
{mean_squared_error(actual_y,y_pred_train,squared=False)})  ")
```

<!DOCTYPE html>

MODEL SUMMARY

ATTEMPT 1

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET	LABEL	ABOVE 150 SEC VALUES	ALPHA = .9	0.58	7.70	0.51776

	MODEL	ENCODING	IMPUTED WITH 100				
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
7.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Mupliple parameters	.65	7.01	.54901
7.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.54901

ATTEMPT 2

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
8.	LASSO REGRESSION MODEL	LABEL ENCODING	REMOVED 12 UNIMPORTANT FEATURES FROM THE DATASET	ALPHA = .9	0.58	7.761	0.51926

ATTEMPT 3

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
9.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .9	0.553	8.29	0.52224
10.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = 400	0.031	12.22	0.12
11.	ELASTICNET REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .7	0.573	8.10	.52685
12.	LASSOLARS MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	NORMALIZE = TRUE	0.555	8.28	.5173
13.	DECISIONTREE REGRESSOR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	0.60	7.86	.54353
14.	SVR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	C Value : 1	8.80	.495	No
15.	XGBOOST MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	--	--	--

GBDT

In [47]:

```
GBDT_Regression(scaled_train,scaled_test)
```

```
Fitting 5 folds for each of 20 candidates, totalling 100 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  25 tasks      | elapsed:   12.6s
[Parallel(n_jobs=-1)]: Done 100 out of 100 | elapsed:   33.0s finished
```

```
params : {'subsample': 0.2, 'min_samples_split': 6, 'min_samples_leaf': 4, 'max_features': 0.55,
'max_depth': 9, 'learning_rate': 0.001} and it's test r2 score is 0.10087123373248594 and it's tra
in r2 score is 0.1134273806858915
params : {'subsample': 0.6, 'min_samples_split': 8, 'min_samples_leaf': 10, 'max_features': 0.55,
'max_depth': 4, 'learning_rate': 0.0025} and it's test r2 score is 0.22658359271738657 and it's tr
ain r2 score is 0.237372381943372
params : {'subsample': 0.1, 'min_samples_split': 7, 'min_samples_leaf': 5, 'max_features': 0.7,
'max_depth': 7, 'learning_rate': 0.02} and it's test r2 score is 0.563776159095793 and it's train
r2 score is 0.61471255193832
params : {'subsample': 0.2, 'min_samples_split': 4, 'min_samples_leaf': 6, 'max_features': 0.4,
'max_depth': 3, 'learning_rate': 0.0025} and it's test r2 score is 0.21923192632038088 and it's tr
ain r2 score is 0.22585927895082394
params : {'subsample': 0.5, 'min_samples_split': 2, 'min_samples_leaf': 4, 'max_features': 0.5,
'max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is 0.10172401515314215 and it's tra
in r2 score is 0.11554888092212545
params : {'subsample': 0.2, 'min_samples_split': 2, 'min_samples_leaf': 3, 'max_features': 0.9,
'max_depth': 4, 'learning_rate': 0.001} and it's test r2 score is 0.10210368259752137 and it's tra
in r2 score is 0.10935753285090369
params : {'subsample': 0.6, 'min_samples_split': 4, 'min_samples_leaf': 5, 'max_features': 0.4,
'max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is 0.10148074566300387 and it's tra
in r2 score is 0.11500105896694868
params : {'subsample': 0.4, 'min_samples_split': 7, 'min_samples_leaf': 9, 'max_features': 0.9,
'max_depth': 2, 'learning_rate': 0.0045} and it's test r2 score is 0.3141741197173853 and it's tra
in r2 score is 0.31921691595477747
params : {'subsample': 0.4, 'min_samples_split': 10, 'min_samples_leaf': 7, 'max_features': 0.3, '
max_depth': 7, 'learning_rate': 0.001} and it's test r2 score is 0.10044656140909339 and it's trai
n r2 score is 0.1110779994662337
params : {'subsample': 0.4, 'min_samples_split': 2, 'min_samples_leaf': 10, 'max_features': 0.4, '
max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is 0.10026146832500704 and it's trai
n r2 score is 0.1118164647696275б
params : {'subsample': 0.4, 'min_samples_split': 4, 'min_samples_leaf': 15, 'max_features': 0.3, '
max_depth': 8, 'learning_rate': 0.0045} and it's test r2 score is 0.34602469647565615 and it's tra
in r2 score is 0.364505351773562
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 6, 'max_features': 0.7,
'max_depth': 2, 'learning_rate': 0.0045} and it's test r2 score is 0.3121840027562136 and it's tra
in r2 score is 0.31801625339366163
params : {'subsample': 0.1, 'min_samples_split': 9, 'min_samples_leaf': 9, 'max_features': 0.5,
'max_depth': 5, 'learning_rate': 0.0045} and it's test r2 score is 0.3383429507079231 and it's tra
in r2 score is 0.34827043679424163
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 10, 'max_features': 0.4, '
max_depth': 3, 'learning_rate': 0.0045} and it's test r2 score is 0.3365041037691413 and it's
train r2 score is 0.3433661387816702
params : {'subsample': 0.5, 'min_samples_split': 3, 'min_samples_leaf': 20, 'max_features': 0.55,
'max_depth': 4, 'learning_rate': 0.001} and it's test r2 score is 0.10059867291531066 and it's tra
in r2 score is 0.10860159657809128
params : {'subsample': 0.5, 'min_samples_split': 8, 'min_samples_leaf': 3, 'max_features': 0.55,
'max_depth': 7, 'learning_rate': 0.007} and it's test r2 score is 0.4449813252703413 and it's trai
n r2 score is 0.48697082584352736
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 4, 'max_features': 0.5,
'max_depth': 2, 'learning_rate': 0.0045} and it's test r2 score is 0.3072381613839184 and it's tra
in r2 score is 0.3129393826384872
params : {'subsample': 0.4, 'min_samples_split': 8, 'min_samples_leaf': 15, 'max_features': 0.4, '
max_depth': 2, 'learning_rate': 0.02} and it's test r2 score is 0.5521691768646895 and it's train
r2 score is 0.5611143209516583
params : {'subsample': 0.2, 'min_samples_split': 7, 'min_samples_leaf': 3, 'max_features': 0.7,
'max_depth': 7, 'learning_rate': 0.02} and it's test r2 score is 0.5529056461116071 and it's train
r2 score is 0.6479172229090915
params : {'subsample': 0.2, 'min_samples_split': 8, 'min_samples_leaf': 10, 'max_features': 0.5, '
max_depth': 7, 'learning_rate': 0.001} and it's test r2 score is 0.1006100819140919 and it's train
r2 score is 0.10994687679671669
Best score: 0.563776159095793
Best params:
learning_rate: 0.02
max_depth: 7
max_features: 0.7
min_samples_leaf: 5
min_samples_split: 7
subsample: 0.1
GBDT best model result : 0.6129257547738622
```

<!DOCTYPE html>

MODEL SUMMARY

ATTEMPT 1

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
7.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Mupliple parameters	.65	7.01	.54901
7.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.54901

ATTEMPT 2

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
8.	LASSO REGRESSION MODEL	LABEL ENCODING	REMOVED 12 UNIMPORTANT FEATURES FROM THE DATASET	ALPHA = .9	0.58	7.761	0.51926

ATTEMPT 3

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
9.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .9	0.553	8.29	0.52224
10.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = 400	0.031	12.22	0.12
11.	ELASTICNET REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .7	0.573	8.10	.52685
12.	LASSOLARS MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	NORMALIZE = TRUE	0.555	8.28	.5173
13.	DECISIONTREE REGRESSOR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	0.60	7.86	.54353
14.	SVR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	C Value : 1	8.80	.495	No
15.	XGBOOST MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY	MultiHyperparameters	--	--	--

	MODEL	ENCODING	WITH 100				
16.	GBDT MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	--	.62	.53003

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

Attempt 4.

<u>My Thought Process:</u> I want to select that model which on hyperparameter tuning gets as closed result on test data also so that, our model will not behave badly on test data i.e Train loss as close as possible with test loss.

NOTE : Now eveything in blue is used in the subsequent model, we will check one by one all our analsys and will see the performance for eg: below we are using onnly 1.1 and 2.2 in the model

1. Y imputation

    1.1 Removing above than 150 sec in Y values with mean of train['y'] i.e. 100 approx.

    1.2 Removing 12 unimportant features from the dataset and check what happend in the performance, i will check only with one model for checking purpose

    1.3 Removing only 265.32 y values with mean of train['y] i.e 100 approx.

1.4 Removing only 265.32 y values with somwe other values other than 100 approx

2. Feature engineering

2.1 For catagorical values use label encoding

    2.2 For catagorical values use one hot encoding encoding

    2.3 Remove ID and use best of the above encoding and see the performance, as ID as per the business problem may have some hidden sequencing information or may be not, we have to see.

    2.4 I will fetch the best features by using all well known feture decompostiiton algorithm.

5.1.1 Linear Regression with Lasso

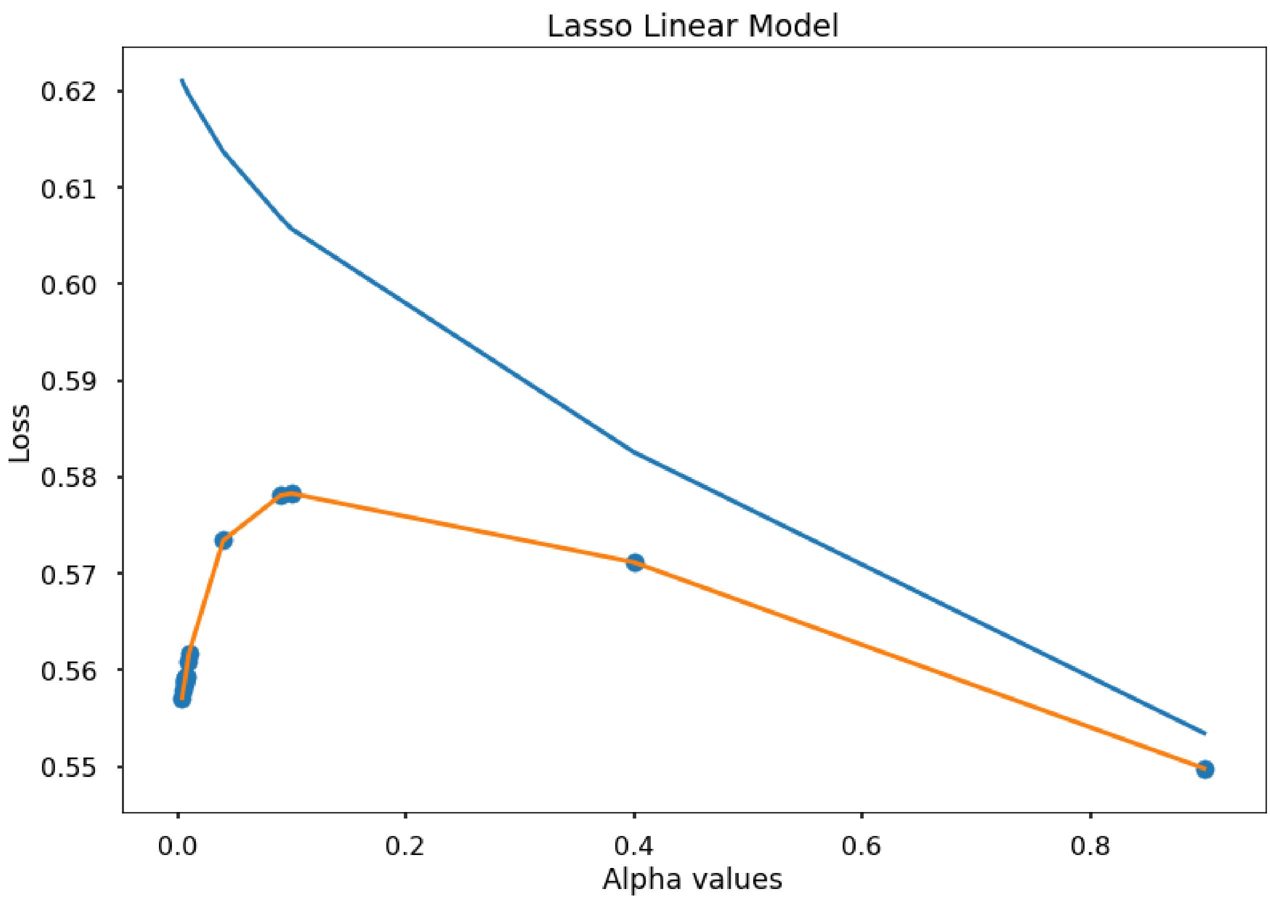
In [131]:

```
plot = Lasso_regression([.004,.005,.006,.0062,.0065,.0067,.0069,.007,.009,.01,.04,.09,.1,.4,.9])
plot.show()
```

```
  0%|                                                                  | 0/15 [00:00<?, ?it/s]
  7%|█████                                                             | 1/15 [00:02:43, 11.68s/it]
 13%|██████████                                                        | 2/15 [00:02:32, 11.70s/it]
```

```
 20%|█████████████████                                                                   | 3/15
[00:35<02:23, 11.93s/it]

 27%|██████████████████████▌                                                             | 4/15 [00:
<02:19, 12.64s/it]

 33%|████████████████████████████                                                        | 5/15 [01:
<02:10, 13.10s/it]

 40%|█████████████████████████████████▋                                                  | 6/15
[01:18<02:01, 13.54s/it]

 47%|███████████████████████████████████████▎                                            | 7/15
[01:33<01:51, 13.96s/it]

 53%|█████████████████████████████████████████████                                       | 8/15 [01:
7<01:37, 13.92s/it]

 60%|██████████████████████████████████████████████████▋                                 | 9/15 [02:
2<01:24, 14.07s/it]

 67%|███████████████████████████████████████████████████████▌                           | 10/15
[02:16<01:10, 14.10s/it]

 73%|█████████████████████████████████████████████████████████████                      | 11/15 [02:
28<00:53, 13.47s/it]
```

```
 80%|████████████████████████████████████████████████████████████████                | 12/15 [02:
39<00:38, 12.76s/it]

 87%|██████████████████████████████████████████████████████████████████████          | 13/15 [02:
49<00:23, 11.83s/it]

 93%|███████████████████████████████████████████████████████████████████████████     | 14/15
[02:52<00:09,  9.34s/it]

100%|████████████████████████████████████████████████████████████████████████████████| 15/15
[02:54<00:00,  7.05s/it]
```



<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> <u>My Thought Process:</u> I am selecting .9 as tuned alpha value here.

In [132]:

```
linear_clf = Lasso(alpha=.9, fit_intercept=True, normalize=False,random_state=23)
```

```
linear_clf = Lasso(alpha=.9, fit_intercept=True, normalize=False,random_state=23)
linear_clf.fit(scaled_train,actual_y)
r_square = r2_score(actual_y,linear_clf.predict(scaled_train))
RMSE = mean_squared_error(actual_y,linear_clf.predict(scaled_train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")

# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = linear_clf.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

```
R_square for train data is : 0.5521739206149533
RMSE for train data is : 8.317756676508028
```

5.1.2 Linear Regression with Ridge

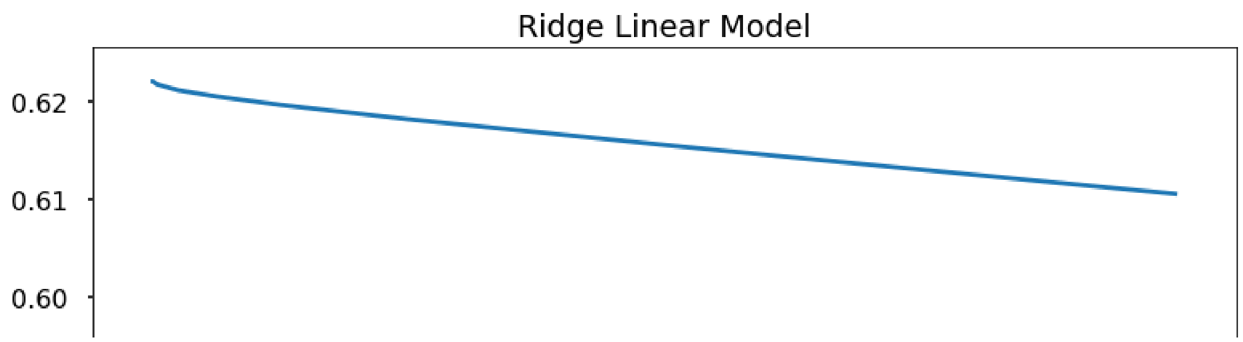
In [142]:

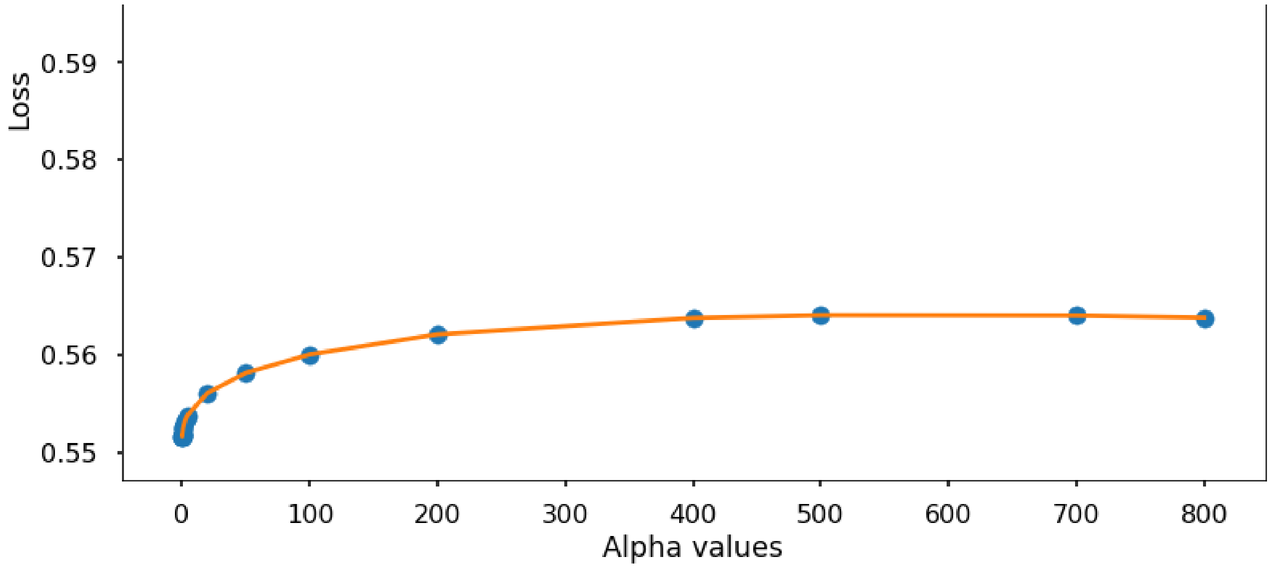
```
alpha = [.000001,.00001,.007,.07,.09,.1,.2,.5,.7,.9,1,2,3,4,20,50,100,200,400,500,700,800]
plot = Ridge_regression(alpha)
plot.show()
```

```
  0%|                                                                          | 0
[00:00<?, ?it/s]

  5%|████                                                                | 1/22 [00:
00:09,  2.13it/s]

  9%|████████                                                            | 2/22 [00:
00:09,  2.10it/s]

 14%|████████████                                                        | 3/22
[00:01<00:08,  2.12it/s]

 18%|████████████████                                                    | 4/22
[00:01<00:08,  2.14it/s]

 23%|████████████████████                                                | 5/22
[00:02<00:08,  2.11it/s]
```

```
 27%|███████████████████████                                                            | 6/22 [00:
<00:07,  2.13it/s]


 32%|███████████████████████████                                                        | 7/22 [00:
<00:07,  2.12it/s]


 36%|███████████████████████████████                                                    | 8/22 [00:
<00:06,  2.06it/s]


 41%|███████████████████████████████████                                                | 9/22
[00:04<00:06,  2.00it/s]


 45%|██████████████████████████████████████                                            | 10/22
[00:04<00:06,  1.98it/s]


 50%|██████████████████████████████████████████                                        | 11/22 [00:
5<00:05,  1.97it/s]


 55%|██████████████████████████████████████████████                                    | 12/22 [00:
5<00:05,  1.95it/s]


 59%|██████████████████████████████████████████████████                                | 13/22 [00:
6<00:04,  1.95it/s]


 64%|█████████████████████████████████████████████████████                             | 14/22 [00:
6<00:04,  1.91it/s]


 68%|█████████████████████████████████████████████████████████                         | 15/22
```

```
[00:07<00:03,  1.90it/s]

 73%|████████████████████████████████▏           | 16/22
[00:07<00:03,  1.94it/s]

 77%|█████████████████████████████████▏          | 17/22 [00:
08<00:02,  1.99it/s]

 82%|████████████████████████████████████        | 18/22 [00:
09<00:02,  1.90it/s]

 86%|█████████████████████████████████████▊      | 19/22 [00:
09<00:01,  1.88it/s]

 91%|████████████████████████████████████████    | 20/22 [00:
10<00:01,  1.87it/s]

 95%|██████████████████████████████████████████  | 21/22
[00:10<00:00,  1.90it/s]

100%|████████████████████████████████████████████| 22/22
[00:11<00:00,  1.94it/s]
```





In [144]:

```
linear_clf = Ridge(alpha=400, fit_intercept=True, normalize=True, max_iter=100,\
                            random_state=23)
linear_clf.fit(train,actual_y)
r_square = r2_score(actual_y,linear_clf.predict(train))
RMSE = mean_squared_error(actual_y,linear_clf.predict(train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")

# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = linear_clf.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

```
R_square for train data is : 0.03140608126574629
RMSE for train data is : 12.232701827492223
```

5.1.3 Linear Regression with Elsatic net

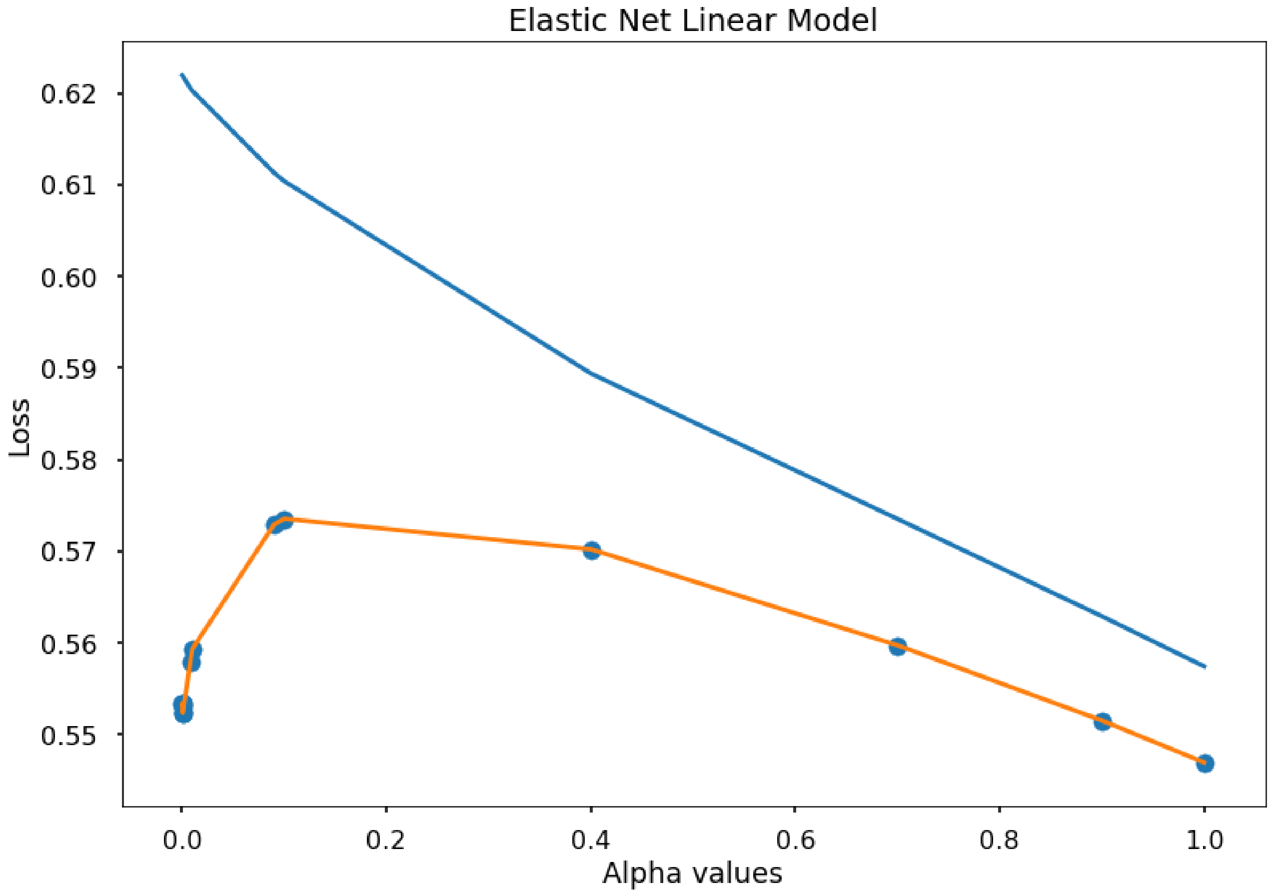
In [146]:

```
alpha = [.0000001,.00001,.0001,.0003,.0005,.0008,.001,.008,.01,.09,.1,.4,.7,.9,1]
plot = Elastic_Net(alpha)
plot.show()
```

```
  0%|                                                                 | 0
[00:00<?, ?it/s]

  7%|█████                                                          | 1/15 [00:
03:12, 13.78s/it]

 13%|██████████                                                     | 2/15 [00:
03:05, 14.26s/it]
```

```
 20%|█████████████████                                                         | 3/15
[00:45<02:57, 14.78s/it]

 27%|██████████████████████▌                                                   | 4/15 [01:
<02:45, 15.01s/it]

 33%|████████████████████████████                                              | 5/15 [01:
<02:34, 15.45s/it]

 40%|█████████████████████████████████▌                                        | 6/15
[01:36<02:30, 16.74s/it]

 47%|███████████████████████████████████████                                   | 7/15
[01:55<02:17, 17.21s/it]

 53%|█████████████████████████████████████████████▌                            | 8/15 [02:
8<01:52, 16.14s/it]

 60%|███████████████████████████████████████████████████                       | 9/15 [02:
2<01:32, 15.41s/it]

 67%|████████████████████████████████████████████████████████                 | 10/15
[02:29<01:04, 12.84s/it]

 73%|█████████████████████████████████████████████████████████████▌           | 11/15 [02:
37<00:45, 11.33s/it]
```

```
 80%|| 12/15 [02:40<00:26,  8.85s/it]

 87%|| 13/15 [02:42<00:13,  6.83s/it]

 93%|| 14/15 [02:43<00:05,  5.16s/it]

100%|| 15/15 [02:44<00:00,  3.97s/it]
```



In [148]:

```
linear_clf = ElasticNet(alpha=.7, fit_intercept=True, normalize=False, max_iter=100,\
                        random_state=23)
linear_clf.fit(scaled_train,actual_y)
r_square = r2_score(actual_y,linear_clf.predict(scaled_train))
RMSE = mean_squared_error(actual_y,linear_clf.predict(scaled_train),squared=False)
```

```
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")

# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = linear_clf.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

```
R_square for train data is : 0.5722589589439504
RMSE for train data is : 8.129090938797297
```

5.1.4 Linear Regression with LARSLasso

In [149]:

```
#https://www.quora.com/What-is-Least-Angle-Regression-and-when-should-it-be-used
# not much hyperparametertuning involved in it.

LassoLars = LassoLarsCV(normalize=True,cv=5)
LassoLars.fit(scaled_train,actual_y)
r_square = r2_score(actual_y,LassoLars.predict(scaled_train))
RMSE = mean_squared_error(actual_y,LassoLars.predict(scaled_train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")
```

```
R_square for train data is : 0.5748773967424698
RMSE for train data is : 8.10417142896398
```

In [150]:

```
# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = LassoLars.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

5.1.5 Decision tree

In [11]:

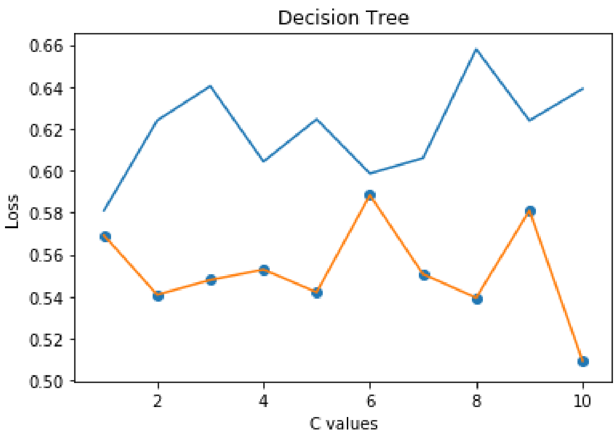
```
from sklearn.tree import DecisionTreeRegressor
a = decision_tree(scaled_train)
plt = a[0]
Decsion_clf = a[1]
```

```
Fitting 10 folds for each of 10 candidates, totalling 100 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  25 tasks      | elapsed:   44.5s
[Parallel(n_jobs=-1)]: Done 100 out of 100 | elapsed:  2.7min finished
```

```
params no 0 : {'min_samples_split': 9, 'max_leaf_nodes': 15, 'max_depth': 10, 'criterion': 'mae'}
test score : [0.5691416663903635]
params no 1 : {'min_samples_split': 7, 'max_leaf_nodes': 500, 'max_depth': 9, 'criterion': 'mae'}
test score : [0.5691416663903635, 0.5408444243195082]
params no 2 : {'min_samples_split': 2, 'max_leaf_nodes': 30, 'max_depth': 9, 'criterion':
'friedman_mse'} test score : [0.5691416663903635, 0.5408444243195082, 0.5479065187405259]
params no 3 : {'min_samples_split': 5, 'max_leaf_nodes': 300, 'max_depth': 7, 'criterion': 'mae'}
test score : [0.5691416663903635, 0.5408444243195082, 0.5479065187405259, 0.5528421222588931]
params no 4 : {'min_samples_split': 4, 'max_leaf_nodes': 100, 'max_depth': 9, 'criterion': 'mae'}
test score : [0.5691416663903635, 0.5408444243195082, 0.5479065187405259, 0.5528421222588931, 0.54
20482255530839]
params no 5 : {'min_samples_split': 5, 'max_leaf_nodes': 50, 'max_depth': 3, 'criterion':
'friedman_mse'} test score : [0.5691416663903635, 0.5408444243195082, 0.5479065187405259,
0.5528421222588931, 0.5420482255530839, 0.5883271215098064]
params no 6 : {'min_samples_split': 2, 'max_leaf_nodes': 45, 'max_depth': 8, 'criterion': 'mae'} t
est score : [0.5691416663903635, 0.5408444243195082, 0.5479065187405259, 0.5528421222588931,
```

```
0.5420482255530839, 0.5883271215098064, 0.5506765330165703]
params no 7 : {'min_samples_split': 4, 'max_leaf_nodes': 300, 'max_depth': 8, 'criterion': 'mse'}
test score : [0.5691416663903635, 0.5408444243195082, 0.5479065187405259, 0.5528421222588931, 0.54
20482255530839, 0.5883271215098064, 0.5506765330165703, 0.5394144075912062]
params no 8 : {'min_samples_split': 3, 'max_leaf_nodes': 1000, 'max_depth': 5, 'criterion': 'mse'}
test score : [0.5691416663903635, 0.5408444243195082, 0.5479065187405259, 0.5528421222588931, 0.54
20482255530839, 0.5883271215098064, 0.5506765330165703, 0.5394144075912062, 0.5809717145613684]
params no 9 : {'min_samples_split': 5, 'max_leaf_nodes': 1000, 'max_depth': 10, 'criterion':
'mae'} test score : [0.5691416663903635, 0.5408444243195082, 0.5479065187405259,
0.5528421222588931, 0.5420482255530839, 0.5883271215098064, 0.5506765330165703,
0.5394144075912062, 0.5809717145613684, 0.5093709147270704]
```



In [13]:

```python
print("Our best score is : ",Decsion_clf.best_score_)
print("Our best estimator : ",Decsion_clf.best_estimator_)

 #lET'S FIND THE KAGGLE SCORE.
DECISONTREE = Decsion_clf.best_estimator_
decision_classfier = best_decison_tree(DECISONTREE,scaled_train)
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = decision_classfier.predict(scaled_test)
sub.to_csv('submission_Final.csv', index=False)
```

```
Our best score is :  0.5883271215098064
Our best estimator :  DecisionTreeRegressor(ccp_alpha=0.0, criterion='friedman_mse', max_depth=3,
                      max_features=None, max_leaf_nodes=50,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=5,
                      min_weight_fraction_leaf=0.0, presort='deprecated',
                      random_state=2, splitter='best')
R_square for train data is : 0.5981000869722461
RMSE for train data is : 7.879714404147236
```

5.1.6 SVR MODEL

In [160]:

```python
C_values = [1,1.2,1.5,2,3,5,10]
train_scores = []
test_scores = []
c_values = []
for i in tqdm(C_values):
    SVR_MODEL = SVR(kernel='rbf', degree=3, gamma='scale', C = i, epsilon=0.2,\
        verbose=3, max_iter=-1)
    SVR_MODEL.fit(scaled_train,actual_y)

    Scores = cross_validate(SVR_MODEL, scaled_train, actual_y, cv=5,scoring=('r2'),\
                            return_train_score=True)
    train_scores.append(np.mean(Scores['train_score']))
    test_scores.append(np.mean(Scores['test_score']))
    c_values.append(i)

plt.title("SVR Model")
```

```
plt.plot(c_values,train_scores)
plt.plot(c_values,test_scores)
plt.scatter(c_values,test_scores)
plt.xlabel("C values")
plt.ylabel("Loss")
```

```
  0%|                                                                      |
[00:00<?, ?it/s]
```

```
[LibSVM][LibSVM][LibSVM][LibSVM][LibSVM][LibSVM]
```

```
 14%|████████                                                  | 1/7
[01:46<10:38, 106.39s/it]
```

```
[LibSVM][LibSVM][LibSVM][LibSVM][LibSVM][LibSVM]
```

```
 29%|████████████████                                          | 2/7 [04:1
09:58, 119.68s/it]
```

```
[LibSVM][LibSVM][LibSVM][LibSVM][LibSVM][LibSVM]
```

```
 43%|█████████████████████████                                 | 3/7
[06:45<08:33, 128.40s/it]
```

```
[LibSVM][LibSVM][LibSVM][LibSVM][LibSVM][LibSVM]
```

```
 57%|█████████████████████████████████                         | 4/7 [09:1
<06:41, 133.98s/it]
```

```
[LibSVM][LibSVM][LibSVM][LibSVM][LibSVM][LibSVM]
```

```
 71%|                                                    | 5/7
[11:36<04:33, 136.78s/it]
```

```
[LibSVM][LibSVM][LibSVM][LibSVM][LibSVM][LibSVM]
```

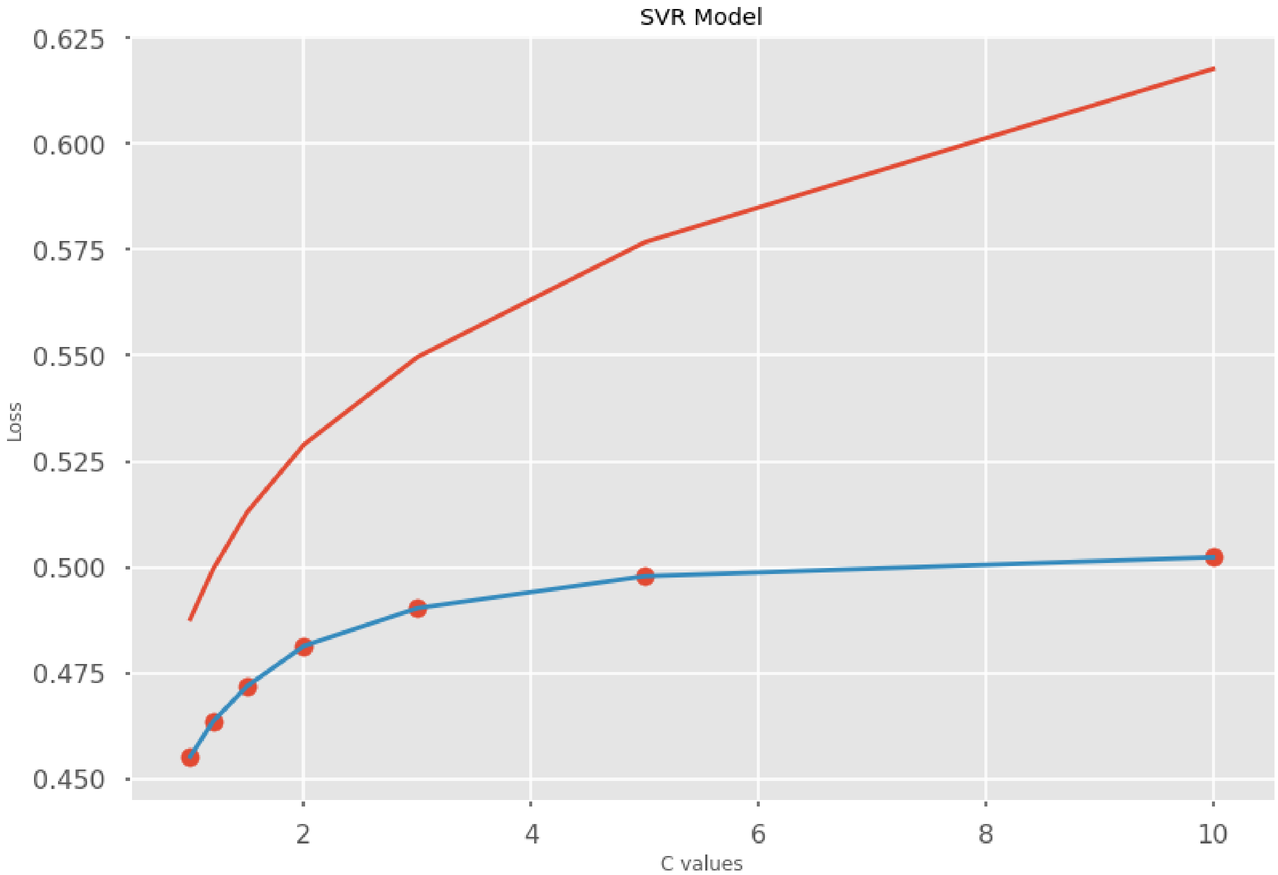
```
 86%|                                                    | 6/7 [14:0
1<02:19, 139.37s/it]
```

```
[LibSVM][LibSVM][LibSVM][LibSVM][LibSVM][LibSVM]
```

```
100%|                                                    | 7/7 [16:
32<00:00, 142.88s/it]
```

Out[160]:

```
Text(0, 0.5, 'Loss')
```



In [161]:

```
SVR_MODEL_FIT(SVR_MODEL)
```

```
[LibSVM]R_square for train data is : 0.4958121217370294
RMSE for train data is : 8.825670736154628
```

In [66]:

```
GBDT_params = {
    'learning_rate': [.00045,.0045,.001,.0025,.007,.001,.02,.01],
    'max_depth': [2,3,4,5,6,7,8,9],
    'max_features': [.2,.3,.4,.5,.55,.7,.9],
    'min_samples_leaf': [1,2,3,4,5,6,7,8,9,10,15,20],
    'min_samples_split': [2,3,4,5,6,7,8,9,10],
    'subsample': [.1,.2,.4,.5,.6]
}



GBDT_clf = GradientBoostingRegressor()


GBDT_clf = RandomizedSearchCV(GBDT_clf, GBDT_params, n_iter=30,
                           n_jobs=-1, verbose=2, cv= 5,
                           scoring='r2', random_state=2,return_train_score=True)

GBDT_clf.fit(scaled_train,actual_y)
```

```
Fitting 5 folds for each of 30 candidates, totalling 150 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  25 tasks      | elapsed:   21.6s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:  1.4min finished
```

Out[66]:

```
RandomizedSearchCV(cv=5, error_score=nan,
                   estimator=GradientBoostingRegressor(alpha=0.9, ccp_alpha=0.0,
                                                       criterion='friedman_mse',
                                                       init=None,
                                                       learning_rate=0.1,
                                                       loss='ls', max_depth=3,
                                                       max_features=None,
                                                       max_leaf_nodes=None,
                                                       min_impurity_decrease=0.0,
                                                       min_impurity_split=None,
                                                       min_samples_leaf=1,
                                                       min_samples_split=2,
                                                       min_weight_fraction_leaf=0.0,
                                                       n_estimators=100,
                                                       n_...
                   param_distributions={'learning_rate': [0.00045, 0.0045,
                                                          0.001, 0.0025, 0.007,
                                                          0.001, 0.02, 0.01],
                                        'max_depth': [2, 3, 4, 5, 6, 7, 8, 9],
                                        'max_features': [0.2, 0.3, 0.4, 0.5,
                                                         0.55, 0.7, 0.9],
                                        'min_samples_leaf': [1, 2, 3, 4, 5, 6,
                                                             7, 8, 9, 10, 15,
                                                             20],
                                        'min_samples_split': [2, 3, 4, 5, 6, 7,
                                                              8, 9, 10],
                                        'subsample': [0.1, 0.2, 0.4, 0.5, 0.6]},
                   pre_dispatch='2*n_jobs', random_state=2, refit=True,
                   return_train_score=True, scoring='r2', verbose=2)
```

In [58]:

```
count = 0
test_result = GBDT_clf.cv_results_["mean_test_score"]
```

```
train_result = GBDT_clf.cv_results_["mean_train_score"]
for i in GBDT_clf.cv_results_['params']:
    print(f"params : {i} and it's test r2 score is {test_result[count]} and it's train r2 score is
{train_result[count]}")
    count+=1
```

```
params : {'subsample': 0.5, 'min_samples_split': 3, 'min_samples_leaf': 15, 'max_features': 0.3, '
max_depth': 2, 'learning_rate': 0.007} and it's test r2 score is 0.3750643860221668 and it's train
r2 score is 0.3812652252381428
params : {'subsample': 0.4, 'min_samples_split': 8, 'min_samples_leaf': 20, 'max_features': 0.7, '
max_depth': 8, 'learning_rate': 0.007} and it's test r2 score is 0.44321143442678235 and it's trai
n r2 score is 0.46633695426101784
params : {'subsample': 0.4, 'min_samples_split': 9, 'min_samples_leaf': 4, 'max_features': 0.9,
'max_depth': 4, 'learning_rate': 0.007} and it's test r2 score is 0.44236313274084005 and it's tra
in r2 score is 0.4611568635048884
params : {'subsample': 0.6, 'min_samples_split': 4, 'min_samples_leaf': 1, 'max_features': 0.5,
'max_depth': 5, 'learning_rate': 0.0025} and it's test r2 score is 0.22143094466046115 and it's tr
ain r2 score is 0.24462961257667035
params : {'subsample': 0.6, 'min_samples_split': 10, 'min_samples_leaf': 20, 'max_features': 0.55,
'max_depth': 9, 'learning_rate': 0.0025} and it's test r2 score is 0.22593960857237913 and it's tr
ain r2 score is 0.24421674807135277
params : {'subsample': 0.5, 'min_samples_split': 5, 'min_samples_leaf': 3, 'max_features': 0.3,
'max_depth': 7, 'learning_rate': 0.0025} and it's test r2 score is 0.22587000824365303 and it's tr
ain r2 score is 0.24702923071334815
params : {'subsample': 0.4, 'min_samples_split': 9, 'min_samples_leaf': 20, 'max_features': 0.9, '
max_depth': 8, 'learning_rate': 0.02} and it's test r2 score is 0.5764400024825418 and it's train
r2 score is 0.6264030770849092
params : {'subsample': 0.2, 'min_samples_split': 8, 'min_samples_leaf': 8, 'max_features': 0.5,
'max_depth': 8, 'learning_rate': 0.0045} and it's test r2 score is 0.3460610756035165 and it's tra
in r2 score is 0.36436161564111486
params : {'subsample': 0.4, 'min_samples_split': 10, 'min_samples_leaf': 4, 'max_features': 0.4, '
max_depth': 6, 'learning_rate': 0.007} and it's test r2 score is 0.4402926824353154 and it's train
r2 score is 0.4708724166588169
params : {'subsample': 0.5, 'min_samples_split': 6, 'min_samples_leaf': 4, 'max_features': 0.5,
'max_depth': 2, 'learning_rate': 0.01} and it's test r2 score is 0.46840377150134477 and it's trai
n r2 score is 0.4745610656332982
params : {'subsample': 0.2, 'min_samples_split': 4, 'min_samples_leaf': 8, 'max_features': 0.5,
'max_depth': 6, 'learning_rate': 0.001} and it's test r2 score is 0.10019846783227515 and it's tra
in r2 score is 0.10915229954683121
params : {'subsample': 0.5, 'min_samples_split': 5, 'min_samples_leaf': 1, 'max_features': 0.3,
'max_depth': 9, 'learning_rate': 0.001} and it's test r2 score is 0.09513725539153821 and it's tra
in r2 score is 0.11852117735051285
params : {'subsample': 0.4, 'min_samples_split': 2, 'min_samples_leaf': 10, 'max_features': 0.7, '
max_depth': 7, 'learning_rate': 0.0025} and it's test r2 score is 0.22583932138197102 and it's tra
in r2 score is 0.24322224186496647
params : {'subsample': 0.6, 'min_samples_split': 3, 'min_samples_leaf': 20, 'max_features': 0.4, '
max_depth': 3, 'learning_rate': 0.007} and it's test r2 score is 0.4329384134872202 and it's train
r2 score is 0.44122337178209997
params : {'subsample': 0.5, 'min_samples_split': 5, 'min_samples_leaf': 6, 'max_features': 0.4,
'max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is 0.0993802765924604 and it's trai
n r2 score is 0.11343980154366548
params : {'subsample': 0.1, 'min_samples_split': 10, 'min_samples_leaf': 4, 'max_features': 0.55,
'max_depth': 4, 'learning_rate': 0.02} and it's test r2 score is 0.5642163540236276 and it's train
r2 score is 0.5918346022943887
params : {'subsample': 0.5, 'min_samples_split': 2, 'min_samples_leaf': 9, 'max_features': 0.3,
'max_depth': 6, 'learning_rate': 0.00045} and it's test r2 score is 0.04298306991729384 and it's t
rain r2 score is 0.05198675940009874
params : {'subsample': 0.1, 'min_samples_split': 3, 'min_samples_leaf': 2, 'max_features': 0.9,
'max_depth': 4, 'learning_rate': 0.0045} and it's test r2 score is 0.3447596269323128 and it's tra
in r2 score is 0.3569174372939251
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 6, 'max_features': 0.7,
'max_depth': 3, 'learning_rate': 0.001} and it's test r2 score is 0.09933378649889332 and it's tra
in r2 score is 0.10656659569562998
params : {'subsample': 0.1, 'min_samples_split': 6, 'min_samples_leaf': 1, 'max_features': 0.3,
'max_depth': 3, 'learning_rate': 0.001} and it's test r2 score is 0.09028181876531509 and it's tra
in r2 score is 0.09846263024552507
params : {'subsample': 0.6, 'min_samples_split': 2, 'min_samples_leaf': 6, 'max_features': 0.3,
'max_depth': 2, 'learning_rate': 0.00045} and it's test r2 score is 0.03288907355374027 and it's t
rain r2 score is 0.04069472451457641
params : {'subsample': 0.1, 'min_samples_split': 6, 'min_samples_leaf': 8, 'max_features': 0.7,
'max_depth': 9, 'learning_rate': 0.0045} and it's test r2 score is 0.3436387907259403 and it's tra
in r2 score is 0.3560975933314653
params : {'subsample': 0.4, 'min_samples_split': 8, 'min_samples_leaf': 4, 'max_features': 0.4,
'max_depth': 5, 'learning_rate': 0.02} and it's test r2 score is 0.5700346496195526 and it's train
r2 score is 0.6233364028910615
params : {'subsample': 0.1, 'min_samples_split': 9, 'min_samples_leaf': 3, 'max_features': 0.3,
```

```
'max_depth': 3, 'learning_rate': 0.001} and it's test r2 score is 0.09285571489946012 and it's tra
in r2 score is 0.09998694760171487
params : {'subsample': 0.2, 'min_samples_split': 3, 'min_samples_leaf': 8, 'max_features': 0.55,
'max_depth': 6, 'learning_rate': 0.02} and it's test r2 score is 0.5678516125087327 and it's train
r2 score is 0.6128519604712348
params : {'subsample': 0.2, 'min_samples_split': 2, 'min_samples_leaf': 15, 'max_features': 0.4, '
max_depth': 3, 'learning_rate': 0.00045} and it's test r2 score is 0.04102039378892326 and it's tr
ain r2 score is 0.0486822057827367
params : {'subsample': 0.1, 'min_samples_split': 9, 'min_samples_leaf': 5, 'max_features': 0.4,
'max_depth': 5, 'learning_rate': 0.0025} and it's test r2 score is 0.22412123841951606 and it's tr
ain r2 score is 0.2327703113970438
params : {'subsample': 0.2, 'min_samples_split': 10, 'min_samples_leaf': 8, 'max_features': 0.4, '
max_depth': 8, 'learning_rate': 0.01} and it's test r2 score is 0.5078091157762364 and it's train
r2 score is 0.5362886001424442
params : {'subsample': 0.2, 'min_samples_split': 6, 'min_samples_leaf': 8, 'max_features': 0.55,
'max_depth': 2, 'learning_rate': 0.01} and it's test r2 score is 0.47058480100694455 and it's trai
n r2 score is 0.4760464317220606
params : {'subsample': 0.6, 'min_samples_split': 3, 'min_samples_leaf': 3, 'max_features': 0.9,
'max_depth': 2, 'learning_rate': 0.02} and it's test r2 score is 0.5620611236017338 and it's train
r2 score is 0.5682344766366744
```

In [ ]:

```
params : {'subsample': 0.4, 'min_samples_split': 9, 'min_samples_leaf': 20, 'max_features': 0.9, 'm
ax_depth': 8,
          'learning_rate': 0.02} and
    it's test r2 score is 0.5764400024825418 and it's train r2 score is 0.6264030770849092
```

In [60]:

```
GBDT_clf.best_estimator_
#.536
```

Out[60]:

```
GradientBoostingRegressor(alpha=0.9, ccp_alpha=0.0, criterion='friedman_mse',
                          init=None, learning_rate=0.02, loss='ls', max_depth=8,
                          max_features=0.9, max_leaf_nodes=None,
                          min_impurity_decrease=0.0, min_impurity_split=None,
                          min_samples_leaf=20, min_samples_split=9,
                          min_weight_fraction_leaf=0.0, n_estimators=100,
                          n_iter_no_change=None, presort='deprecated',
                          random_state=None, subsample=0.4, tol=0.0001,
                          validation_fraction=0.1, verbose=0, warm_start=False)
```

In [67]:

```
GBDT_clf.best_estimator_
```

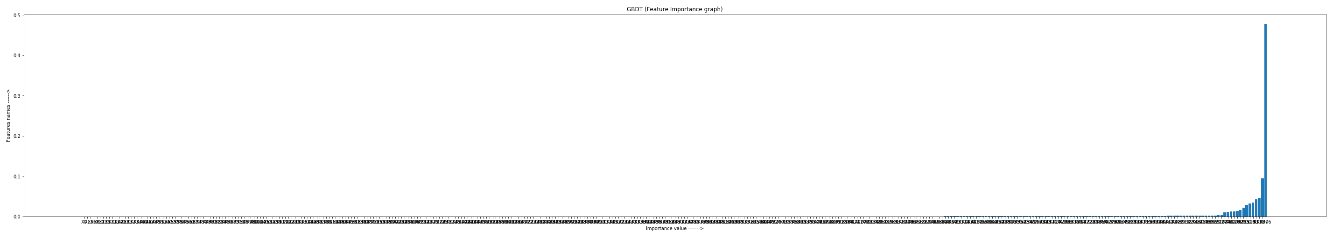
Out[67]:

```
GradientBoostingRegressor(alpha=0.9, ccp_alpha=0.0, criterion='friedman_mse',
                          init=None, learning_rate=0.02, loss='ls', max_depth=7,
                          max_features=0.7, max_leaf_nodes=None,
                          min_impurity_decrease=0.0, min_impurity_split=None,
                          min_samples_leaf=5, min_samples_split=7,
                          min_weight_fraction_leaf=0.0, n_estimators=100,
                          n_iter_no_change=None, presort='deprecated',
                          random_state=None, subsample=0.1, tol=0.0001,
                          validation_fraction=0.1, verbose=0, warm_start=False)
```

In [63]:

```
zipped = zip(train.columns.to_list(),list(GBDT_model.feature_importances_))
# Using sorted and lambda
res = sorted(zipped, key = lambda x: x[1])
res_GBDT= []
for i in res:
    if(i[1] > 0 or i[1] < 0):
        res_GBDT.append(i)
plt.figure(figsize=(50,8))
plt.title("GBDT (Feature Importance graph)")
plt.bar([i[0] for i in res],[i[1] for i in res])
```

```python
plt.bar([i[0] for i in res],[i[1] for i in res])
plt.xlabel("Importance value ------->")
plt.ylabel("Features names ------>")
plt.show()

print(f"GBDT Features : {[i[0] for i in res_GBDT] }" )
```




```
GBDT Features : ['X151', 'X19', 'X140', 'X266', 'X100', 'X363', 'X297', 'X325', 'X337', 'X370', 'X
135', 'X353', 'X194', 'X30', 'X344', 'X109', 'X352', 'X220', 'X167', 'X71', 'X3', 'X359', 'X276',
'X338', 'X130', 'X335', 'X103', 'X171', 'X295', 'X334', 'X248', 'X221', 'X90', 'X177', 'X93',
'X187', 'X201', 'X351', 'X278', 'X169', 'X184', 'X41', 'X14', 'X211', 'X127', 'X101', 'X70',
'X239', 'X139', 'X242', 'X29', 'X61', 'X302', 'X15', 'X368', 'X11', 'X332', 'X320', 'X174',
'X233', 'X286', 'X37', 'X156', 'X22', 'X12', 'X62', 'X293', 'X44', 'X35', 'X366', 'X308', 'X226',
'X243', 'X360', 'X179', 'X27', 'X112', 'X328', 'X143', 'X178', 'X341', 'X131', 'X125', 'X63',
'X60', 'X88', 'X148', 'X145', 'X230', 'X141', 'X238', 'X292', 'X305', 'X223', 'X355', 'X354',
'X329', 'X154', 'X369', 'X77', 'X160', 'X173', 'X318', 'X348', 'X217', 'X170', 'X124', 'X192',
'X42', 'X236', 'X95', 'X153', 'X316', 'X136', 'X218', 'X147', 'X172', 'X216', 'X326', 'X313',
'X106', 'X350', 'X267', 'X73', 'X275', 'X50', 'X76', 'X134', 'X277', 'X53', 'X108', 'X163',
'X129', 'X347', 'X319', 'X215', 'X150', 'X257', 'X367', 'X268', 'X142', 'X343', 'X342', 'X182',
'X4', 'X321', 'X39', 'X212', 'X92', 'X2', 'X38', 'X43', 'X346', 'X210', 'X265', 'X56', 'X155', 'X1
8', 'X271', 'X107', 'X224', 'X46', 'X20', 'X128', 'X180', 'X67', 'X255', 'X110', 'X118', 'X253', '
ID', 'X111', 'X307', 'X306']
```

<!DOCTYPE html>

MODEL SUMMARY

ATTEMPT 1

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
7.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Mupliple parameters	.65	7.01	.54901
7.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.54901

ATTEMPT 2

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
8.	LASSO REGRESSION MODEL	LABEL ENCODING	REMOVED 12 UNIMPORTANT FEATURES FROM THE DATASET	ALPHA = .9	0.58	7.761	0.51926

ATTEMPT 3

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
9.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .9	0.553	8.29	0.52224
10.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = 400	0.031	12.22	0.12
11.	ELASTICNET REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .7	0.573	8.10	.52685
12.	LASSOLARS MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	NORMALIZE = TRUE	0.555	8.28	.5173
13.	DECISIONTREE REGRESSOR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	0.60	7.86	.54353
14.	SVR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	C Value : 1	8.80	.495	No
15.	XGBOOST MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	--	--	--
16.	GBDT MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	--	.62	.53003

ATTEMPT 4

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

Attempt 5.

<u>My Thought Process:</u> I want to select that model which on hyperparameter tuning gets as closed result on test data also so that, our model will not behave badly on test data i.e Train loss as close as possible with test loss.

NOTE : Now eveything in blue is used in the subsequent model, we will check one by one all our analsys and will see the performance for eg: below we are using onnly 1.1 and 2.2 in the model, From abpve analysis i can see that Y imputstion with 130 is giving me goof result from now on i will continue with that imputation only.

1. Y imputation

1.4 Removing only 265.32 y values with somwe other values other than 100 approx

2. Feature engineering

```
2.1 For catagorical values use label encoding

2.2 For catagorical values use one hot encoding encoding

2.3 Remove ID and use best of the above encoding and see the performance, as ID as per t
he business problem may have some hidden sequencing information or may be not, we have t
o see.

2.4 I will fetch the best features by using all well known feture decompostiiton
```

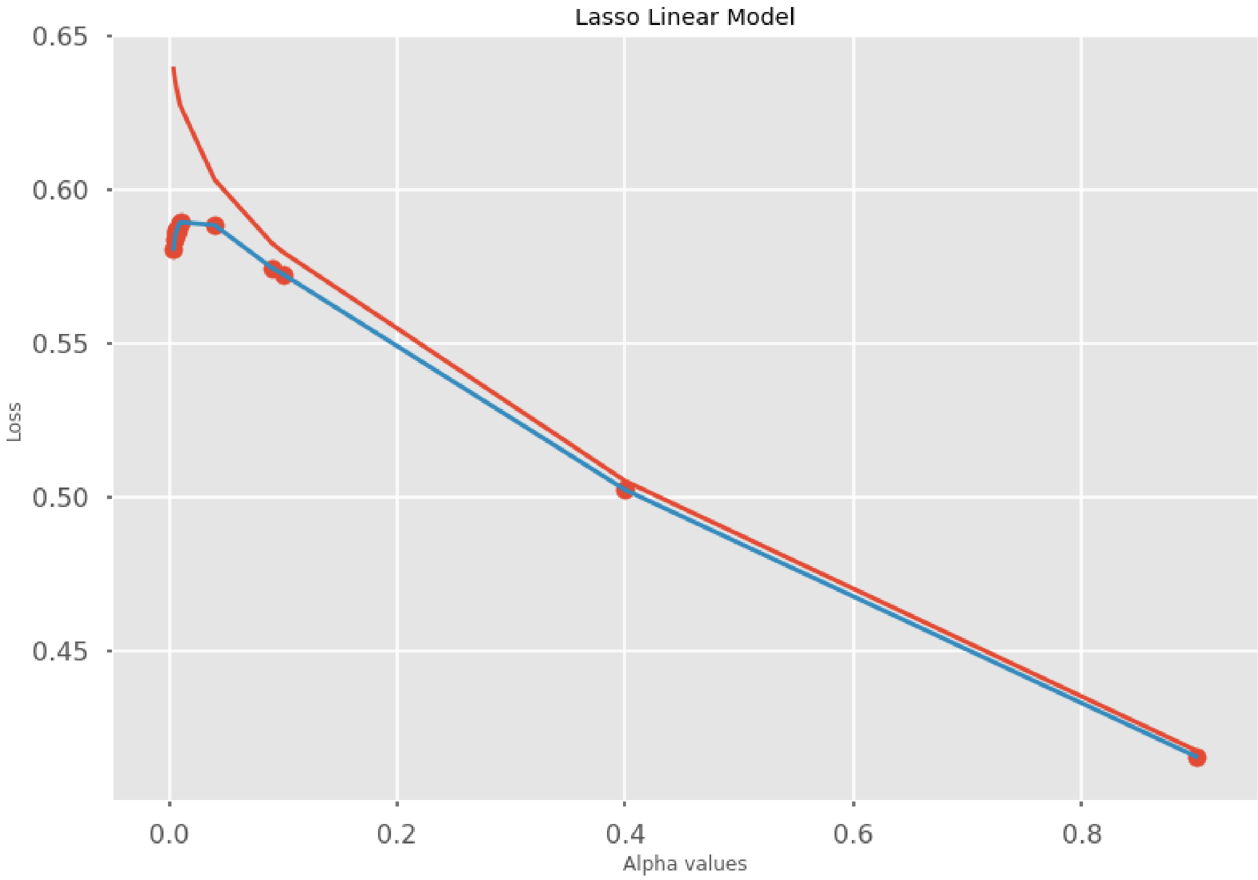
algorithm PCA,TSVD etc..

2.4 Concatenate orignal features with decomposed features.

NOTE : I will not be using SVR(RGF) anymore as it is not giving good result

5.1.1 Linear Regression with LASSO

In [175]:

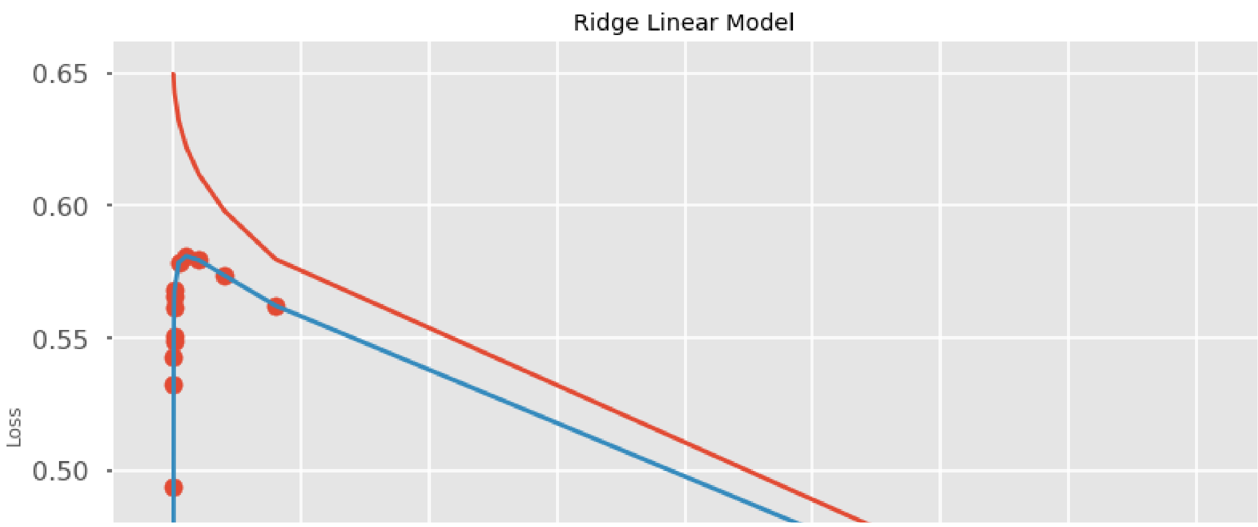


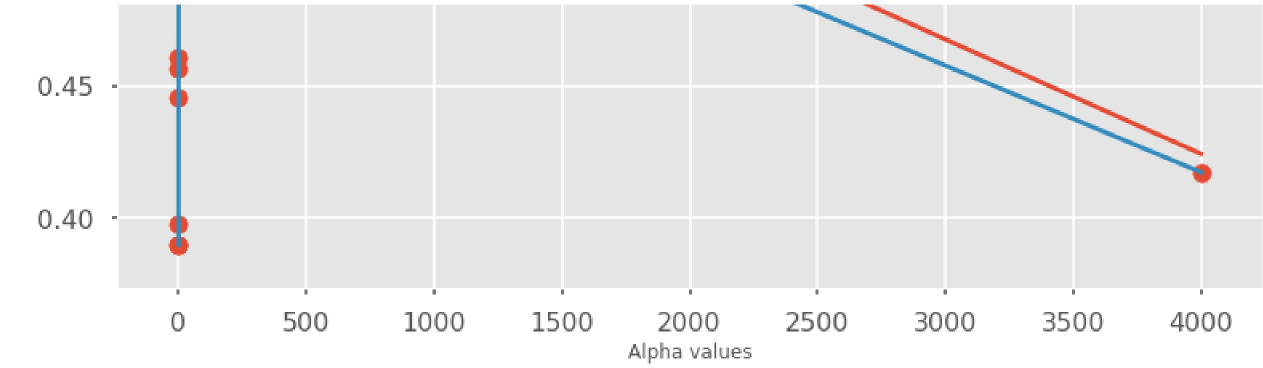
In [176]:

```
R_square for train data is : 0.5814969988574878
RMSE for train data is : 8.040828684609442
```

5.1.2 Linear Regression with Ridge

In [177]:



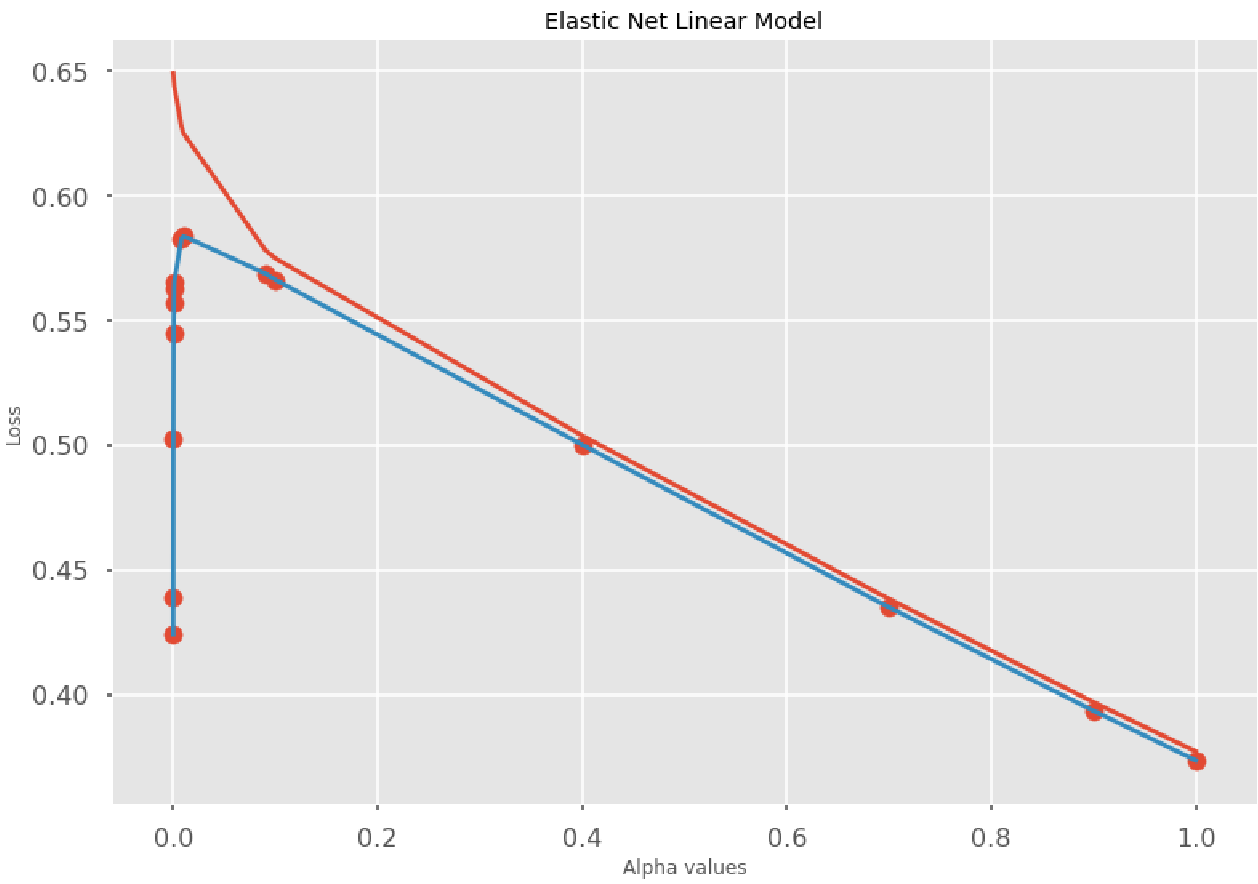


In [181]:

```
R_square for train data is : 0.03587298013719831
RMSE for train data is : 12.204462239411164
```

5.1.3 Linear Regression with Elsatic net

In [182]:



In [184]:

```
R_square for train data is : 0.5773028047374413
RMSE for train data is : 8.081020416162238
```

5.1.4 Linear Regression with LARSLasso

In [186]:

```
R_square for train data is : 0.5668932539134959
RMSE for train data is : 8.17991884770895
```

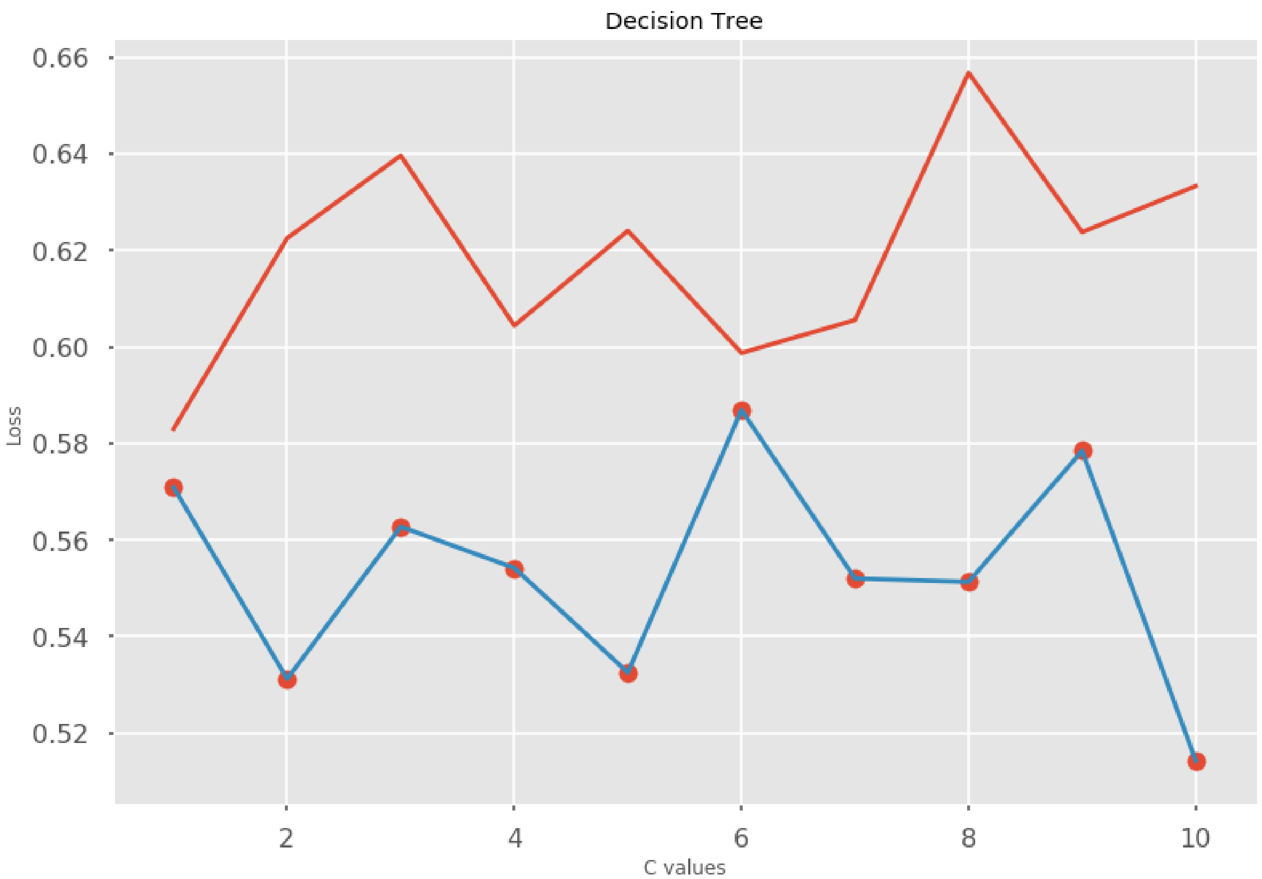
5.1.5 Decision tree

In [196]:

```
Fitting 10 folds for each of 10 candidates, totalling 100 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  25 tasks      | elapsed:   44.9s
[Parallel(n_jobs=-1)]: Done 100 out of 100 | elapsed:  2.9min finished
```

```
params no 0 : {'min_samples_split': 9, 'max_leaf_nodes': 15, 'max_depth': 10, 'criterion':
'mae'} test score : [0.5708724192894354]
params no 1 : {'min_samples_split': 7, 'max_leaf_nodes': 500, 'max_depth': 9, 'criterion':
'mae'} test score : [0.5708724192894354, 0.5312071091610512]
params no 2 : {'min_samples_split': 2, 'max_leaf_nodes': 30, 'max_depth': 9, 'criterion':
'friedman_mse'} test score : [0.5708724192894354, 0.5312071091610512, 0.5627087949255974]
params no 3 : {'min_samples_split': 5, 'max_leaf_nodes': 300, 'max_depth': 7, 'criterion':
'mae'} test score : [0.5708724192894354, 0.5312071091610512, 0.5627087949255974,
0.5541821465567455]
params no 4 : {'min_samples_split': 4, 'max_leaf_nodes': 100, 'max_depth': 9, 'criterion':
'mae'} test score : [0.5708724192894354, 0.5312071091610512, 0.5627087949255974,
0.5541821465567455, 0.5325202957046534]
params no 5 : {'min_samples_split': 5, 'max_leaf_nodes': 50, 'max_depth': 3, 'criterion':
'friedman_mse'} test score : [0.5708724192894354, 0.5312071091610512, 0.5627087949255974,
0.5541821465567455, 0.5325202957046534, 0.5869005012343049]
params no 6 : {'min_samples_split': 2, 'max_leaf_nodes': 45, 'max_depth': 8, 'criterion':
'mae'} test score : [0.5708724192894354, 0.5312071091610512, 0.5627087949255974,
0.5541821465567455, 0.5325202957046534, 0.5869005012343049, 0.5519998558967256]
params no 7 : {'min_samples_split': 4, 'max_leaf_nodes': 300, 'max_depth': 8, 'criterion':
'mse'} test score : [0.5708724192894354, 0.5312071091610512, 0.5627087949255974,
0.5541821465567455, 0.5325202957046534, 0.5869005012343049, 0.5519998558967256,
0.5512927127362255]
params no 8 : {'min_samples_split': 3, 'max_leaf_nodes': 1000, 'max_depth': 5, 'criterion':
'mse'} test score : [0.5708724192894354, 0.5312071091610512, 0.5627087949255974,
0.5541821465567455, 0.5325202957046534, 0.5869005012343049, 0.5519998558967256,
0.5512927127362255, 0.5784344265021261]
params no 9 : {'min_samples_split': 5, 'max_leaf_nodes': 1000, 'max_depth': 10, 'criterion':
'mae'} test score : [0.5708724192894354, 0.5312071091610512, 0.5627087949255974,
0.5541821465567455, 0.5325202957046534, 0.5869005012343049, 0.5519998558967256,
0.5512927127362255, 0.5784344265021261, 0.5142853786505656]
```



In [198]:

```
Our best score is :  0.5869005012343049
Our best estimator :  DecisionTreeRegressor(ccp_alpha=0.0, criterion='friedman_mse',
max_depth=3,
                      max_features=None, max_leaf_nodes=50,
```

```
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=5,
                      min_weight_fraction_leaf=0.0, presort='deprecated',
                      random_state=2, splitter='best')
R_square for train data is : 0.5981000869722463
RMSE for train data is : 7.879714404147235
```

5.1.6 XGBOOST

In [ ]:

```
Parameters are :(3, 100, 0.001, 0.93)
Total iteration :24
Total iteration remaining :24
##############################################################################################################
[01:56:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[01:56:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[01:56:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[01:56:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[01:56:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[0] train-rmse:100.805+0.124565 test-rmse:100.804+0.498155
[3] train-rmse:100.506+0.124153 test-rmse:100.504+0.496546
[6] train-rmse:100.207+0.123752 test-rmse:100.206+0.494935
[9] train-rmse:99.9088+0.123434 test-rmse:99.9076+0.493241
[12] train-rmse:99.6117+0.123082 test-rmse:99.6105+0.491586
[15] train-rmse:99.3156+0.122686 test-rmse:99.3143+0.489987
[18] train-rmse:99.0203+0.122322 test-rmse:99.019+0.488362
[21] train-rmse:98.7259+0.121922 test-rmse:98.7247+0.486777
[24] train-rmse:98.4324+0.121503 test-rmse:98.4312+0.485224
[27] train-rmse:98.1398+0.121154 test-rmse:98.1386+0.483605
[30] train-rmse:97.8481+0.120803 test-rmse:97.8469+0.482002
[33] train-rmse:97.5572+0.120427 test-rmse:97.556+0.480421
[36] train-rmse:97.2673+0.120035 test-rmse:97.2661+0.478868
[39] train-rmse:96.9782+0.119643 test-rmse:96.977+0.477318
[42] train-rmse:96.6899+0.119274 test-rmse:96.6888+0.475751
[45] train-rmse:96.4026+0.118854 test-rmse:96.4014+0.474232
[48] train-rmse:96.1161+0.118483 test-rmse:96.1149+0.472686
[51] train-rmse:95.8304+0.11811 test-rmse:95.8293+0.471143
[54] train-rmse:95.5457+0.117727 test-rmse:95.5446+0.469617
[57] train-rmse:95.2618+0.117353 test-rmse:95.2606+0.468082
[60] train-rmse:94.9787+0.116981 test-rmse:94.9776+0.466556
[63] train-rmse:94.6965+0.116636 test-rmse:94.6954+0.465014
[66] train-rmse:94.4151+0.116292 test-rmse:94.414+0.463469
[69] train-rmse:94.1346+0.115895 test-rmse:94.1335+0.461984
[72] train-rmse:93.8549+0.115536 test-rmse:93.8538+0.460477
[75] train-rmse:93.5761+0.115184 test-rmse:93.575+0.458954
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##########################################################################################
##########
Parameters are :(3, 100, 0.001, 0.95)
Total iteration :24
Total iteration remaining :23
##########################################################################################
##########
[02:00:08] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:00:08] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:00:08] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
```

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reg:squarederror.
[02:00:08] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:00:08] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
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################################################################################################
##########
Parameters are :(3, 100, 0.0045, 0.93)
Total iteration :24
Total iteration remaining :22
################################################################################################
##########
[02:03:32] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:03:32] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:03:32] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:03:32] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:03:32] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[0] train-rmse:100.455+0.124029 test-rmse:100.454+0.496317
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[51] train-rmse:79.988+0.0974041 test-rmse:79.9873+0.386896
[54] train-rmse:78.9255+0.0959882 test-rmse:78.9249+0.381433
```

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###############################################################################################
##########
Parameters are :(3, 100, 0.0045, 0.95)
Total iteration :24
Total iteration remaining :21
###############################################################################################
##########
[02:06:04] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:06:05] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:06:05] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:06:05] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:06:05] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
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################################################################################################
##########
Parameters are :(3, 400, 0.001, 0.93)
Total iteration :24
Total iteration remaining :20
################################################################################################
##########
[02:08:41] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:08:42] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:08:42] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:08:42] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:08:42] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
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[1699] train-rmse:20.0475+0.023947 test-rmse:20.0631+0.194953
################################################################################################
##########
Parameters are :(3, 400, 0.001, 0.95)
Total iteration :24
Total iteration remaining :19
################################################################################################
##########
[02:12:06] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:12:06] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:12:06] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:12:06] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
```

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win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:12:06] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[0] train-rmse:100.805+0.124578 test-rmse:100.804+0.498152
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[1362] train-rmse:26.9769+0.0301999 test-rmse:26.9838+0.189466
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```

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################################################################################################
##########
Parameters are :(3, 400, 0.0045, 0.93)
Total iteration :24
Total iteration remaining :18
################################################################################################
##########
[02:15:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:15:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:15:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:15:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:15:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[0] train-rmse:100.455+0.124029 test-rmse:100.454+0.496317
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```

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```

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##########################################################################################
##########
Parameters are :(3, 400, 0.0045, 0.95)
Total iteration :24
Total iteration remaining :17
##########################################################################################
##########
[02:18:01] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:18:01] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:18:01] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:18:01] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:18:01] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
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################################################################################################
##########
Parameters are :(3, 520, 0.001, 0.93)
Total iteration :24
Total iteration remaining :16
################################################################################################
##########
[02:20:36] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:20:36] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:20:37] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:20:37] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:20:37] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
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################################################################################################
##########
Parameters are :(3, 520, 0.001, 0.95)
Total iteration :24
Total iteration remaining :15
################################################################################################
##########
[02:24:01] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:24:01] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:24:01] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:24:02] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:24:02] WARNING: C:/Jenkins/workspace/xgboost-
```

```
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[0] train-rmse:100.805+0.124578 test-rmse:100.804+0.498152
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##############################################################################################################
Parameters are :(3, 520, 0.0045, 0.93)
Total iteration :24
Total iteration remaining :14
##############################################################################################################
[02:27:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[02:27:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[02:27:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[02:27:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[02:27:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
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[1212] train-rmse:7.57994+0.0575015 test-rmse:7.92144+0.220716
[1215] train-rmse:7.57864+0.057598 test-rmse:7.92117+0.220704
[1218] train-rmse:7.57735+0.0576059 test-rmse:7.92105+0.220766
[1221] train-rmse:7.57615+0.0576767 test-rmse:7.92058+0.22088
```

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[1224] train-rmse:7.57503+0.0577182 test-rmse:7.92027+0.220811
[1227] train-rmse:7.5736+0.057455 test-rmse:7.92013+0.221002
[1230] train-rmse:7.57243+0.0572413 test-rmse:7.91992+0.220965
[1233] train-rmse:7.57102+0.0572649 test-rmse:7.91966+0.220732
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[1239] train-rmse:7.56869+0.0571348 test-rmse:7.9193+0.220521
[1242] train-rmse:7.5675+0.0570629 test-rmse:7.91916+0.220433
[1245] train-rmse:7.56631+0.0570612 test-rmse:7.91903+0.220379
[1248] train-rmse:7.56508+0.0570587 test-rmse:7.91887+0.220451
[1251] train-rmse:7.56394+0.0570068 test-rmse:7.91883+0.220598
[1254] train-rmse:7.56283+0.0571393 test-rmse:7.91874+0.220767
[1257] train-rmse:7.56152+0.0571454 test-rmse:7.91858+0.220787
[1260] train-rmse:7.5602+0.0571091 test-rmse:7.91865+0.220905
##########################################################################################
##########
Parameters are :(3, 520, 0.0045, 0.95)
Total iteration :24
Total iteration remaining :13
##########################################################################################
##########
[02:29:55] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:29:55] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:29:56] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:29:56] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:29:56] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[0] train-rmse:100.455+0.124072 test-rmse:100.454+0.496295
[3] train-rmse:99.1156+0.122243 test-rmse:99.1144+0.489091
[6] train-rmse:97.7942+0.120414 test-rmse:97.793+0.482054
[9] train-rmse:96.4907+0.119056 test-rmse:96.4895+0.47466
[12] train-rmse:95.2047+0.11747 test-rmse:95.2036+0.467594
[15] train-rmse:93.9361+0.11578 test-rmse:93.935+0.460782
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[39] train-rmse:84.3866+0.103264 test-rmse:84.3858+0.409842
[42] train-rmse:83.2643+0.101855 test-rmse:83.2636+0.403885
[45] train-rmse:82.1573+0.100326 test-rmse:82.1566+0.398204
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```

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```

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##############################################################################################
##########
Parameters are :(4, 100, 0.001, 0.93)
Total iteration :24
Total iteration remaining :12
##############################################################################################
##########
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reg:squarederror.
[02:32:30] WARNING: C:/Jenkins/workspace/xgboost-
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reg:squarederror.
[02:32:30] WARNING: C:/Jenkins/workspace/xgboost-
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reg:squarederror.
[02:32:30] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:32:30] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
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################################################################################################
##########
Parameters are :(4, 100, 0.001, 0.95)
Total iteration :24
Total iteration remaining :11
################################################################################################
##########
[02:36:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:36:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:36:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:36:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:36:30] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[0] train-rmse:100.805+0.124578 test-rmse:100.804+0.498152
```

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############################################################################################################
Parameters are :(4, 100, 0.0045, 0.93)
Total iteration :24
Total iteration remaining :10
############################################################################################################
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[02:40:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[02:40:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[02:40:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[02:40:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
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[1029] train-rmse:7.49766+0.0610314 test-rmse:7.98205+0.231407
[1032] train-rmse:7.4943+0.0611751 test-rmse:7.98065+0.231325
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[1233] train-rmse:7.33755+0.0619322 test-rmse:7.94129+0.229171
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[1242] train-rmse:7.33211+0.0617117 test-rmse:7.94097+0.228846
[1245] train-rmse:7.33038+0.0616321 test-rmse:7.94095+0.228866
##################################################################################################
##########
Parameters are :(4, 100, 0.0045, 0.95)
Total iteration :24
Total iteration remaining :9
##################################################################################################
##########
[02:43:24] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:43:24] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:43:24] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:43:25] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:43:25] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[0] train-rmse:100.455+0.124072 test-rmse:100.454+0.496295
[3] train-rmse:99.1156+0.122243 test-rmse:99.1144+0.489091
[6] train-rmse:97.7942+0.120414 test-rmse:97.793+0.482054
[9] train-rmse:96.4907+0.119056 test-rmse:96.4895+0.47466
[12] train-rmse:95.2047+0.11747 test-rmse:95.2036+0.467594
[15] train-rmse:93.9361+0.11578 test-rmse:93.935+0.460782
[18] train-rmse:92.6848+0.114189 test-rmse:92.6837+0.454012
[21] train-rmse:91.4503+0.1125 test-rmse:91.4493+0.44743
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[30] train-rmse:87.8464+0.107856 test-rmse:87.8454+0.428118
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###########################################################################################
##########
Parameters are :(4, 400, 0.001, 0.93)
Total iteration :24
Total iteration remaining :8
###########################################################################################
##########
[02:46:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:46:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:46:29] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[02:46:29] WARNING: C:/Jenkins/workspace/xgboost-
```

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[02:46:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[02:46:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
[0] train-rmse:100.805+0.124565 test-rmse:100.804+0.498155
[3] train-rmse:100.506+0.124153 test-rmse:100.504+0.496546
[6] train-rmse:100.207+0.123752 test-rmse:100.206+0.494935
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[12] train-rmse:99.6117+0.123082 test-rmse:99.6105+0.491586
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```

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[246] train-rmse:78.9989+0.0966523 test-rmse:78.9983+0.381215
[249] train-rmse:78.7649+0.0963795 test-rmse:78.7644+0.379978
[252] train-rmse:78.5317+0.0960861 test-rmse:78.5311+0.37875
[255] train-rmse:78.2991+0.0958102 test-rmse:78.2986+0.377521
[258] train-rmse:78.0672+0.0955016 test-rmse:78.0667+0.376338
[261] train-rmse:77.8361+0.0952721 test-rmse:77.8356+0.375076
[264] train-rmse:77.6056+0.0949525 test-rmse:77.6051+0.373904
[267] train-rmse:77.3759+0.0946409 test-rmse:77.3754+0.372719
[270] train-rmse:77.1468+0.094295 test-rmse:77.1463+0.371576
[273] train-rmse:76.9184+0.0939711 test-rmse:76.9179+0.370422
[276] train-rmse:76.6906+0.0936878 test-rmse:76.6902+0.36923
[279] train-rmse:76.4637+0.0934401 test-rmse:76.4633+0.368015
[282] train-rmse:76.2374+0.0931819 test-rmse:76.237+0.366811
[285] train-rmse:76.0118+0.092903 test-rmse:76.0113+0.365627
[288] train-rmse:75.7868+0.0926074 test-rmse:75.7864+0.36448
[291] train-rmse:75.5626+0.0923535 test-rmse:75.5622+0.363284
[294] train-rmse:75.339+0.092081 test-rmse:75.3386+0.362123
[297] train-rmse:75.1161+0.0917894 test-rmse:75.1157+0.360983
[300] train-rmse:74.8939+0.0914851 test-rmse:74.8935+0.359856
[303] train-rmse:74.6724+0.0911898 test-rmse:74.672+0.358724
[306] train-rmse:74.4515+0.0908737 test-rmse:74.4511+0.357621
[309] train-rmse:74.2313+0.0905643 test-rmse:74.2309+0.356514
[312] train-rmse:74.0117+0.0902553 test-rmse:74.0114+0.355433
[315] train-rmse:73.7928+0.0899779 test-rmse:73.7925+0.354311
[318] train-rmse:73.5746+0.0897274 test-rmse:73.5742+0.353167
[321] train-rmse:73.3569+0.0894242 test-rmse:73.3566+0.35208
[324] train-rmse:73.14+0.0891446 test-rmse:73.1397+0.350967
[327] train-rmse:72.9237+0.08886 test-rmse:72.9234+0.349871
[330] train-rmse:72.7082+0.0885302 test-rmse:72.7079+0.348825
[333] train-rmse:72.4932+0.0882449 test-rmse:72.4929+0.347754
[336] train-rmse:72.2789+0.0879428 test-rmse:72.2786+0.34669
[339] train-rmse:72.0653+0.0877073 test-rmse:72.065+0.345568
[342] train-rmse:71.8523+0.0874027 test-rmse:71.852+0.344523
[345] train-rmse:71.6399+0.0871474 test-rmse:71.6396+0.343412
[348] train-rmse:71.4282+0.0868788 test-rmse:71.4279+0.342345
[351] train-rmse:71.2171+0.0866227 test-rmse:71.2169+0.341275
[354] train-rmse:71.0066+0.086383 test-rmse:71.0064+0.340178
[357] train-rmse:70.7968+0.086065 test-rmse:70.7966+0.339162
[360] train-rmse:70.5876+0.0857866 test-rmse:70.5874+0.33811
[363] train-rmse:70.3791+0.085533 test-rmse:70.3789+0.337032
[366] train-rmse:70.1712+0.0853057 test-rmse:70.171+0.335945
[369] train-rmse:69.9639+0.0850381 test-rmse:69.9638+0.334902
[372] train-rmse:69.7573+0.0847241 test-rmse:69.7571+0.333918
[375] train-rmse:69.5513+0.0844187 test-rmse:69.5511+0.332926
[378] train-rmse:69.3459+0.0841472 test-rmse:69.3458+0.331907
[381] train-rmse:69.1412+0.0839155 test-rmse:69.141+0.330854
[384] train-rmse:68.937+0.0837215 test-rmse:68.9369+0.32977
[387] train-rmse:68.7336+0.0833866 test-rmse:68.7334+0.328837
[390] train-rmse:68.5306+0.0831721 test-rmse:68.5305+0.327789
[393] train-rmse:68.3283+0.0829394 test-rmse:68.3282+0.326751
[396] train-rmse:68.1267+0.0826765 test-rmse:68.1266+0.32575
```

In [11]:

```
[02:56:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of reg:squarederror.
(r2  : 0.6274554026273124 and mean_squared_error 7.586485912997156)
```

GBDT REGRESSOR

In [6]:

```
Fitting 5 folds for each of 20 candidates, totalling 100 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  25 tasks      | elapsed:   20.4s
[Parallel(n_jobs=-1)]: Done 100 out of 100 | elapsed:   56.8s finished
```

```
params : {'subsample': 0.2, 'min_samples_split': 6, 'min_samples_leaf': 4, 'max_features': 0.55,
'max_depth': 9, 'learning_rate': 0.001} and it's test r2 score is -0.007848425466225906 and it'
s train r2 score is 0.010177388522913477
params : {'subsample': 0.6, 'min_samples_split': 8, 'min_samples_leaf': 10, 'max_features':
0.55, 'max_depth': 4, 'learning_rate': 0.0025} and it's test r2 score is -0.007248506419532586
and it's train r2 score is 0.009836484872685536
params : {'subsample': 0.1, 'min_samples_split': 7, 'min_samples_leaf': 5, 'max_features': 0.7,
'max_depth': 7, 'learning_rate': 0.02} and it's test r2 score is -0.019277246632999477 and it's
train r2 score is 0.07162558657707843
params : {'subsample': 0.2, 'min_samples_split': 4, 'min_samples_leaf': 6, 'max_features': 0.4,
'max_depth': 3, 'learning_rate': 0.0025} and it's test r2 score is -0.007545008697336453 and it
's train r2 score is 0.005387394194031092
params : {'subsample': 0.5, 'min_samples_split': 2, 'min_samples_leaf': 4, 'max_features': 0.5,
'max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is -0.007987396449620432 and it'
s train r2 score is 0.01213622620689898
params : {'subsample': 0.2, 'min_samples_split': 2, 'min_samples_leaf': 3, 'max_features': 0.9,
'max_depth': 4, 'learning_rate': 0.001} and it's test r2 score is -0.007779444937211766 and it'
s train r2 score is 0.004153501338400134
params : {'subsample': 0.6, 'min_samples_split': 4, 'min_samples_leaf': 5, 'max_features': 0.4,
'max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is -0.007746714721366166 and it'
s train r2 score is 0.01200416968030098
params : {'subsample': 0.4, 'min_samples_split': 7, 'min_samples_leaf': 9, 'max_features': 0.9,
'max_depth': 2, 'learning_rate': 0.0045} and it's test r2 score is -0.007560139532540644 and it
's train r2 score is 0.006887573423583549
params : {'subsample': 0.4, 'min_samples_split': 10, 'min_samples_leaf': 7, 'max_features':
0.3, 'max_depth': 7, 'learning_rate': 0.001} and it's test r2 score is -0.007561138735764495 an
d it's train r2 score is 0.007734658523013161
params : {'subsample': 0.4, 'min_samples_split': 2, 'min_samples_leaf': 10, 'max_features':
0.4, 'max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is -0.00760814957540572 and
it's train r2 score is 0.008982928319222205
params : {'subsample': 0.4, 'min_samples_split': 4, 'min_samples_leaf': 15, 'max_features':
0.3, 'max_depth': 8, 'learning_rate': 0.0045} and it's test r2 score is -0.00795824551717006
and it's train r2 score is 0.02933334115447117
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 6, 'max_features': 0.7,
'max_depth': 2, 'learning_rate': 0.0045} and it's test r2 score is -0.006726446794086805 and it
's train r2 score is 0.006353561878023451
params : {'subsample': 0.1, 'min_samples_split': 9, 'min_samples_leaf': 9, 'max_features': 0.5,
'max_depth': 5, 'learning_rate': 0.0045} and it's test r2 score is -0.008031117938290321 and it
's train r2 score is 0.01321944484234423
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 10, 'max_features':
0.4, 'max_depth': 3, 'learning_rate': 0.0045} and it's test r2 score is -0.006535749720885997 a
nd it's train r2 score is 0.008353133869232332
params : {'subsample': 0.5, 'min_samples_split': 3, 'min_samples_leaf': 20, 'max_features':
0.55, 'max_depth': 4, 'learning_rate': 0.001} and it's test r2 score is -0.007471123965017812 a
nd it's train r2 score is 0.003586507542646178
params : {'subsample': 0.5, 'min_samples_split': 8, 'min_samples_leaf': 3, 'max_features': 0.55,
'max_depth': 7, 'learning_rate': 0.007} and it's test r2 score is -0.010124453644001895 and it'
s train r2 score is 0.05913392495767247
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 4, 'max_features': 0.5,
'max_depth': 2, 'learning_rate': 0.0045} and it's test r2 score is -0.007091398199070964 and it
's train r2 score is 0.005899585381615257
params : {'subsample': 0.4, 'min_samples_split': 8, 'min_samples_leaf': 15, 'max_features':
0.4, 'max_depth': 2, 'learning_rate': 0.02} and it's test r2 score is -0.009198706088743468 and
it's train r2 score is 0.018516473356773
params : {'subsample': 0.2, 'min_samples_split': 7, 'min_samples_leaf': 3, 'max_features': 0.7,
'max_depth': 7, 'learning_rate': 0.02} and it's test r2 score is -0.03746362081423875 and it's
train r2 score is 0.11150761373586078
params : {'subsample': 0.2, 'min_samples_split': 8, 'min_samples_leaf': 10, 'max_features':
0.5, 'max_depth': 7, 'learning_rate': 0.001} and it's test r2 score is -0.007514056077781972 an
d it's train r2 score is 0.00579793007547078
Best score: -0.006535749720885997
Best params:
learning_rate: 0.0045
max_depth: 3
max_features: 0.4
min_samples_leaf: 10
min_samples_split: 9
subsample: 0.2
GBDT best model result : 0.0075450173415440025
```

<!DOCTYPE html>

MODEL SUMMARY

ATTEMPT 1

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
16.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .9	.5521	8.31	0.52215
17.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.031	12.23	-
7.	ELASTICNET REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .7	0.572	8.12	.52693-
18.	LASSOLARS MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .7	0.59	8.104	.53496-
19.	DECISIONTREE REGRESSOR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	Mutli-Parameters	0.60	7.86	.54356
20.	SVR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	C = .7	0.49	8.8	.42905-
21.	GBDT MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	Multiple parameters	.5921	8.01	.5421-

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
7.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Mupliple parameters	.65	7.01	.54901
8.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.54901

ATTEMPT 2

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
	LASSO	LABEL	REMOVED 12 UNIMPORTANT				

8.	REGRESSION MODEL	LABEL ENCODING	FEATURES FROM THE DATASET	ALPHA = .9	0.58	7.761	0.51926

ATTEMPT 3

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
9.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .9	0.553	8.29	0.52224
10.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = 400	0.031	12.22	0.12
11.	ELASTICNET REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .7	0.573	8.10	.52685
12.	LASSOLARS MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	NORMALIZE = TRUE	0.555	8.28	.5173
13.	DECISIONTREE REGRESSOR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	0.60	7.86	.54353
14.	SVR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	C Value : 1	8.80	.495	No
15.	XGBOOST MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	--	--	--
16.	GBDT MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	--	.62	.53003

ATTEMPT 4

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
16.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .9	.5521	8.31	0.52215
17.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.031	12.23	-
7.	ELASTICNET REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .7	0.572	8.12	.52693-
18.	LASSOLARS MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .7	0.59	8.104	.53496-
19.	DECISIONTREE REGRESSOR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	Mutli-Parameters	0.60	7.86	.54356
20.	SVR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	C = .7	0.49	8.8	.42905-
21.	GBDT MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	Multiple parameters	.5921	8.01	.5421-

ATTEMPT 5

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
21.	LASSO MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .09	0.58	8.04	.53174-
22.	RIDGE MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.035	12.20	--
			iMPUTED				

23.	ELASTICNET MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.577	8.08	.52921
24.	LARSLASSO MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.566	8.17	.52329
25.	DECISION TREE MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	Multi parameters	0.59	8.17	.54356
25.	XGBOOST MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	Multi parameters	0.62	7.52	.5356
25.	GBDT REGRESSOR	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	Multi parameters	NO	NO	NO

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

Attempt 6.

My Thought Process: I want to select that model which on hyperparameter tuning gets as closed result on test data also so that, our model will not behave badly on test data i.e Train loss as close as possible with test loss.

NOTE : Now eveything in blue is used in the subsequent model, we will check one by one all our analsys and will see the performance for eg: below we are using onnly 1.1 and 2.2 in the model, From abpve analysis i can see that Y imputstion with 130 is giving me goof result from now on i will continue with that imputation only.

1. Y imputation

1.4 Removing only 265.32 y values with somwe other values other than 100 approx

2. Feature engineering

2.1 For catagorical values use label encoding

2.2 For catagorical values use one hot encoding encoding

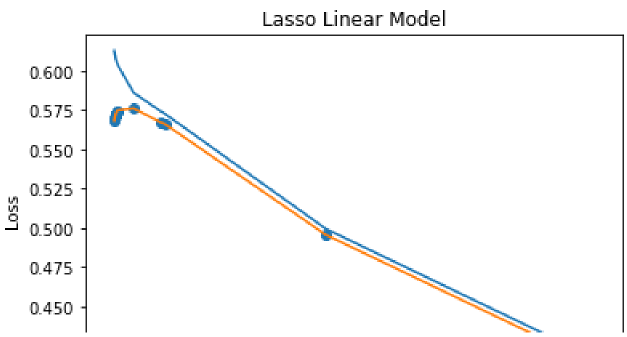
2.3 Will remove ID feature and use best of the above encoding and see the performance, as ID as per the business problem may have some hidden sequencing information or may be not, we have to see.

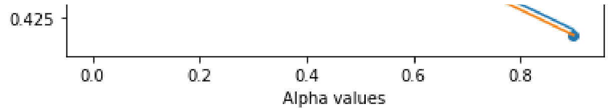
2.4 I will fetch the best features by using all well known feature decompostiiton algorithm concatenate with original features.

Lasso Regression

In [20]:

```
plot = Lasso_regression([.004,.005,.006,.0062,.0065,.0067,.0069,.007,.009,.01,.04,.09,.1,.4,.9],scaled_train.drop("ID",axis = 1))
plot.show()
```





In [21]:

```
linear_clf = Lasso(alpha=.04, fit_intercept=True, normalize=False,random_state=23)
linear_clf.fit(scaled_train.drop("ID",axis = 1),actual_y)
r_square = r2_score(actual_y,linear_clf.predict(scaled_train.drop("ID",axis = 1)))
RMSE = mean_squared_error(actual_y,linear_clf.predict(scaled_train.drop("ID",axis =
1)),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")

# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = linear_clf.predict(scaled_test.drop("ID",axis = 1))
sub.to_csv('submission_Final.csv', index=False)
#Kaggle : .53370
```

```
R_square for train data is : 0.5851996763260194
RMSE for train data is : 8.005179309555716
```

Decision Tree

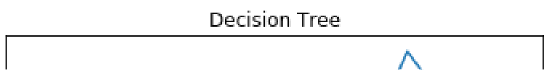
In [22]:

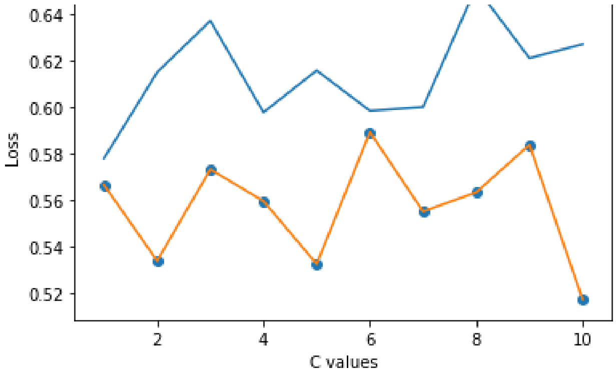
```
from sklearn.tree import DecisionTreeRegressor
a = decision_tree(scaled_train.drop("ID",axis=1))
plt = a[0]
Decsion_clf = a[1]
```

```
Fitting 10 folds for each of 10 candidates, totalling 100 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  25 tasks      | elapsed:  1.0min
[Parallel(n_jobs=-1)]: Done 100 out of 100 | elapsed:  2.9min finished
```

```
params no 0 : {'min_samples_split': 9, 'max_leaf_nodes': 15, 'max_depth': 10, 'criterion': 'mae'}
test score : [0.5666155841718358]
params no 1 : {'min_samples_split': 7, 'max_leaf_nodes': 500, 'max_depth': 9, 'criterion': 'mae'}
test score : [0.5666155841718358, 0.5340096857866927]
params no 2 : {'min_samples_split': 2, 'max_leaf_nodes': 30, 'max_depth': 9, 'criterion':
'friedman_mse'} test score : [0.5666155841718358, 0.5340096857866927, 0.5732944802045745]
params no 3 : {'min_samples_split': 5, 'max_leaf_nodes': 300, 'max_depth': 7, 'criterion': 'mae'}
test score : [0.5666155841718358, 0.5340096857866927, 0.5732944802045745, 0.5596613233643057]
params no 4 : {'min_samples_split': 4, 'max_leaf_nodes': 100, 'max_depth': 9, 'criterion': 'mae'}
test score : [0.5666155841718358, 0.5340096857866927, 0.5732944802045745, 0.5596613233643057, 0.53
26557553234647]
params no 5 : {'min_samples_split': 5, 'max_leaf_nodes': 50, 'max_depth': 3, 'criterion':
'friedman_mse'} test score : [0.5666155841718358, 0.5340096857866927, 0.5732944802045745,
0.5596613233643057, 0.5326557553234647, 0.589246789534758]
params no 6 : {'min_samples_split': 2, 'max_leaf_nodes': 45, 'max_depth': 8, 'criterion': 'mae'} t
est score : [0.5666155841718358, 0.5340096857866927, 0.5732944802045745, 0.5596613233643057,
0.5326557553234647, 0.589246789534758, 0.5552307584681355]
params no 7 : {'min_samples_split': 4, 'max_leaf_nodes': 300, 'max_depth': 8, 'criterion': 'mse'}
test score : [0.5666155841718358, 0.5340096857866927, 0.5732944802045745, 0.5596613233643057, 0.53
26557553234647, 0.589246789534758, 0.5552307584681355, 0.5634233640092796]
params no 8 : {'min_samples_split': 3, 'max_leaf_nodes': 1000, 'max_depth': 5, 'criterion': 'mse'}
test score : [0.5666155841718358, 0.5340096857866927, 0.5732944802045745, 0.5596613233643057, 0.53
26557553234647, 0.589246789534758, 0.5552307584681355, 0.5634233640092796, 0.5838081541851962]
params no 9 : {'min_samples_split': 5, 'max_leaf_nodes': 1000, 'max_depth': 10, 'criterion':
'mae'} test score : [0.5666155841718358, 0.5340096857866927, 0.5732944802045745,
0.5596613233643057, 0.5326557553234647, 0.589246789534758, 0.5552307584681355, 0.5634233640092796,
0.5838081541851962, 0.5175748561702243]
```





In [23]:

```
print("Our best score is : ",Decsion_clf.best_score_)
print("Our best estimator : ",Decsion_clf.best_estimator_)
```

```
Our best score is :  0.589246789534758
Our best estimator :  DecisionTreeRegressor(ccp_alpha=0.0, criterion='friedman_mse', max_depth=3,
                      max_features=None, max_leaf_nodes=50,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=5,
                      min_weight_fraction_leaf=0.0, presort='deprecated',
                      random_state=2, splitter='best')
```

In [25]:

```
#lET'S FIND THE KAGGLE SCORE.
DECISONTREE = DecisionTreeRegressor(ccp_alpha=0.0, criterion='friedman_mse', max_depth=3,
                      max_features=None, max_leaf_nodes=50,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=5,
                      min_weight_fraction_leaf=0.0, presort='deprecated',
                      random_state=2, splitter='best')

decision_classfier = best_decison_tree(DECISONTREE,scaled_train.drop("ID",axis = 1))
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = decision_classfier.predict(scaled_test.drop("ID",axis = 1))
sub.to_csv('submission_Final.csv', index=False)
#kaggle score : .54218
```

```
R_square for train data is : 0.5978833321496284
RMSE for train data is : 7.881838982701878
```

LARSLASSO

In [22]:

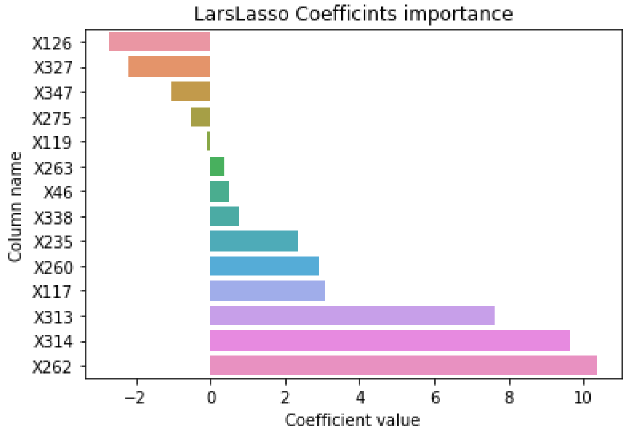
```
LassoLars = LassoLarsCV(normalize=True,cv=5)
LassoLars.fit(scaled_train.drop("ID",axis = 1),actual_y)
r_square = r2_score(actual_y,LassoLars.predict(scaled_train.drop("ID",axis = 1)))
RMSE = mean_squared_error(actual_y,LassoLars.predict(scaled_train.drop("ID",axis =
1)),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")
```

```
R_square for train data is : 0.5460008457105476
RMSE for train data is : 8.37488867578143
```

In [23]:

```
coef_ = [i for i in sorted(zip(LassoLars.coef_,train.columns), key = lambda x : x[0]) if i[0]!=0.0]
sns.barplot([i[0] for i in coef_], [i[1] for i in coef_])
plt.title("LarsLasso Coefficints importance")
plt.xlabel("Coefficient value")
plt.ylabel("Column name")
```

```
plt.show()
```



In [27]:

```
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = LassoLars.predict(scaled_test.drop("ID",axis = 1))
sub.to_csv('submission_Final.csv', index=False)
# Kaggle Score : 0.50646
```

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process: From Above attempts i can see that attempt 4 is working well.

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

Attempt 7.

My Thought Process: I want to select that model which on hyperparameter tuning gets as closed result on test data also so that, our model will not behave badly on test data i.e Train loss as close as possible with test loss.

NOTE : Now eveything in blue is used in the subsequent model, we will check one by one all our analsys and will see the performance for eg: below we are using onnly 1.1 and 2.2 in the model, From abpve analysis i can see that Y imputstion with 130 is giving me goof result from now on i will continue with that imputation only.

1. Y imputation

1.4 Removing only 265.32 y values with somwe other values other than 100 approx

2. Feature engineering

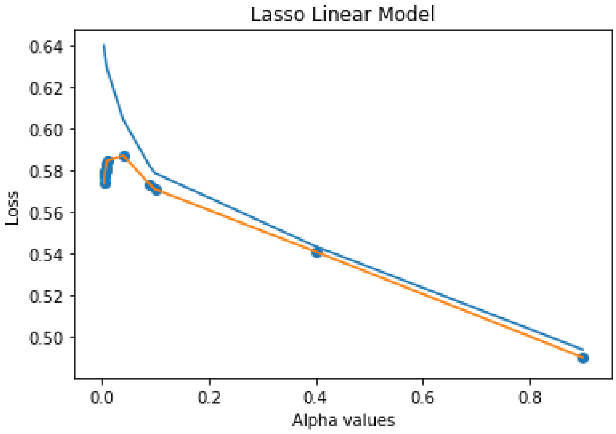
```
2.1 For catagorical values use label encoding

2.2 For catagorical values use one hot encoding encoding

2.3 Will remove ID feature and use best of the above encoding and see the performance, as I
D as per the business problem may have some hidden sequencing information or may be not, we
have to see.

2.4 I will fetch the best features by using all well known feature decompostiiton algorithm
concatenate with original features.
```

5.1.4 Linear Regression with LARSLasso

In [8]:

```
plot =
Lasso_regression([.004,.005,.006,.0062,.0065,.0067,.0069,.007,.009,.01,.04,.09,.1,.4,.9],decomposed_
```

```
train)
plot.show()
```



In [22]:

```
linear_clf = Lasso(alpha=.09, fit_intercept=True, normalize=False,random_state=23)
linear_clf.fit(decomposed_train,actual_y)
r_square = r2_score(actual_y,linear_clf.predict(decomposed_train))
RMSE = mean_squared_error(actual_y,linear_clf.predict(decomposed_train),squared=False)
print(f"R_square for train data is : {r_square}")
print(f"RMSE for train data is : {RMSE}")

# lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = linear_clf.predict(decomposed_test)
sub.to_csv('submission_Final.csv', index=False)
```

```
R_square for train data is : 0.5808797022248608
RMSE for train data is : 8.04675665582214
```

5.1.5 Decision tree

In [10]:

```
from sklearn.tree import DecisionTreeRegressor
a = decision_tree(decomposed_train)
plt = a[0]
Decsion_clf = a[1]
```

```
Fitting 10 folds for each of 10 candidates, totalling 100 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  25 tasks      | elapsed: 12.8min
[Parallel(n_jobs=-1)]: Done 100 out of 100 | elapsed: 56.2min finished
```

```
params no 0 : {'min_samples_split': 9, 'max_leaf_nodes': 15, 'max_depth': 10, 'criterion': 'mae'}
test score : [0.5490913354614936]
params no 1 : {'min_samples_split': 7, 'max_leaf_nodes': 500, 'max_depth': 9, 'criterion': 'mae'}
test score : [0.5490913354614936, 0.4785924141384482]
params no 2 : {'min_samples_split': 2, 'max_leaf_nodes': 30, 'max_depth': 9, 'criterion':
'friedman_mse'} test score : [0.5490913354614936, 0.4785924141384482, 0.5070468348219606]
params no 3 : {'min_samples_split': 5, 'max_leaf_nodes': 300, 'max_depth': 7, 'criterion': 'mae'}
test score : [0.5490913354614936, 0.4785924141384482, 0.5070468348219606, 0.4900096917552571]
params no 4 : {'min_samples_split': 4, 'max_leaf_nodes': 100, 'max_depth': 9, 'criterion': 'mae'}
test score : [0.5490913354614936, 0.4785924141384482, 0.5070468348219606, 0.4900096917552571, 0.47
13079528883764]
params no 5 : {'min_samples_split': 5, 'max_leaf_nodes': 50, 'max_depth': 3, 'criterion':
'friedman_mse'} test score : [0.5490913354614936, 0.4785924141384482, 0.5070468348219606,
0.4900096917552571, 0.4713079528883764, 0.5734695777186427]
params no 6 : {'min_samples_split': 2, 'max_leaf_nodes': 45, 'max_depth': 8, 'criterion': 'mae'} t
```

```
est score : [0.5490913354614936, 0.4785924141384482, 0.5070468348219606, 0.4900096917552571, 0.4713079528883764, 0.5734695777186427, 0.4976437907164417]
params no 7 : {'min_samples_split': 4, 'max_leaf_nodes': 300, 'max_depth': 8, 'criterion': 'mse'}
test score : [0.5490913354614936, 0.4785924141384482, 0.5070468348219606, 0.4900096917552571, 0.4713079528883764, 0.5734695777186427, 0.4976437907164417, 0.4966908064170469]
params no 8 : {'min_samples_split': 3, 'max_leaf_nodes': 1000, 'max_depth': 5, 'criterion': 'mse'}
test score : [0.5490913354614936, 0.4785924141384482, 0.5070468348219606, 0.4900096917552571, 0.4713079528883764, 0.5734695777186427, 0.4976437907164417, 0.4966908064170469, 0.5319407785555021]
params no 9 : {'min_samples_split': 5, 'max_leaf_nodes': 1000, 'max_depth': 10, 'criterion': 'mae'} test score : [0.5490913354614936, 0.4785924141384482, 0.5070468348219606, 0.4900096917552571, 0.4713079528883764, 0.5734695777186427, 0.4976437907164417, 0.4966908064170469, 0.5319407785555021, 0.47509697567089343]
```

In [11]:

```python
print("Our best score is : ",Decsion_clf.best_score_)
print("Our best estimator : ",Decsion_clf.best_estimator_)
```

```
Our best score is :  0.5734695777186427
Our best estimator :  DecisionTreeRegressor(ccp_alpha=0.0, criterion='friedman_mse', max_depth=3,
                      max_features=None, max_leaf_nodes=50,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=5,
                      min_weight_fraction_leaf=0.0, presort='deprecated',
                      random_state=2, splitter='best')
```

In [21]:

```python
#lET'S FIND THE KAGGLE SCORE.
DECISONTREE = DecisionTreeRegressor(ccp_alpha=0.0, criterion='friedman_mse', max_depth=3,
                      max_features=None, max_leaf_nodes=50,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=5,
                      min_weight_fraction_leaf=0.0, presort='deprecated',
                      random_state=2, splitter='best')

decision_classfier = best_decison_tree(DECISONTREE,decomposed_train)
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = decision_classfier.predict(decomposed_test)
sub.to_csv('submission_Final.csv', index=False)
```

```
R_square for train data is : 0.6049369669373551
RMSE for train data is : 7.812404432362868
```

5.1.6 XGBOOST

In [ ]:

```python
'''Cross validation the xgb model then predict the test data'''

max_depths = [3,4]
n_treess = [100,400,520]
etas = [.001,.0045]
```

```
subsamples = [.93,.95]
count = 0
dtrain = xgb.DMatrix(decomposed_train, actual_y)
dtest = xgb.DMatrix(decomposed_test)

# GRID SEARCH
for max_depth in max_depths:
    for n_trees in n_treess:
        for eta in etas:
            for subsample in subsamples:
                xgb_params = {
                            'n_trees': n_trees,
                            'max_depth': max_depth,
                            'eta': eta,
                            'subsample': subsample,
                            'objective': 'reg:linear',
                            'eval_metric': 'rmse',
                        }
                print(f"Parameters are :{max_depth,n_trees,eta,subsample}")
                print(f"Total iteration :{len(max_depths)*len(n_treess)*len(etas)*len(subsamples)}'
)
                print(f"Total iteration remaining :
{len(max_depths)*len(n_treess)*len(etas)*len(subsamples) - (count)}")
                print("#"*110)
                count+=1
                # NOTE: Make sure that the class is labeled 'class' in the data file
                num_boost_rounds = 5000
                XGBOOST_CV = xgb.cv(xgb_params, dtrain, nfold=5,
verbose_eval=3,early_stopping_rounds=5, num_boost_round=num_boost_rounds)
                print("#"*110)
```

```
Parameters are :(3, 100, 0.001, 0.93)
Total iteration :24
Total iteration remaining :24
###############################################################################################################
#######
[22:32:21] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[22:32:21] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[22:32:21] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[22:32:21] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[22:32:21] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
[0] train-rmse:100.805+0.124565 test-rmse:100.804+0.498155
[3] train-rmse:100.506+0.124153 test-rmse:100.504+0.496546
[6] train-rmse:100.207+0.123752 test-rmse:100.206+0.494935
[9] train-rmse:99.9088+0.123434 test-rmse:99.9076+0.493241
[12] train-rmse:99.6117+0.123082 test-rmse:99.6105+0.491586
[15] train-rmse:99.3156+0.122686 test-rmse:99.3143+0.489987
[18] train-rmse:99.0203+0.122322 test-rmse:99.019+0.488362
[21] train-rmse:98.7259+0.121922 test-rmse:98.7247+0.486777
[24] train-rmse:98.4324+0.121503 test-rmse:98.4312+0.485224
[27] train-rmse:98.1398+0.121154 test-rmse:98.1386+0.483605
[30] train-rmse:97.8481+0.120803 test-rmse:97.8469+0.482002
[33] train-rmse:97.5572+0.120427 test-rmse:97.556+0.480421
[36] train-rmse:97.2673+0.120035 test-rmse:97.2661+0.478868
[39] train-rmse:96.9782+0.119643 test-rmse:96.977+0.477318
[42] train-rmse:96.6899+0.119274 test-rmse:96.6888+0.475751
[45] train-rmse:96.4026+0.118854 test-rmse:96.4014+0.474232
[48] train-rmse:96.1161+0.118483 test-rmse:96.1149+0.472686
[51] train-rmse:95.8304+0.11811 test-rmse:95.8293+0.471143
[54] train-rmse:95.5457+0.117727 test-rmse:95.5446+0.469617
[57] train-rmse:95.2618+0.117353 test-rmse:95.2606+0.468082
[60] train-rmse:94.9787+0.116981 test-rmse:94.9776+0.466556
[63] train-rmse:94.6965+0.116636 test-rmse:94.6954+0.465014
[66] train-rmse:94.4151+0.116292 test-rmse:94.414+0.463469
[69] train-rmse:94.1346+0.115895 test-rmse:94.1335+0.461984
```

```
[72] train-rmse:93.8549+0.115536 test-rmse:93.8538+0.460477
[75] train-rmse:93.5761+0.115184 test-rmse:93.575+0.458954
[78] train-rmse:93.2982+0.114847 test-rmse:93.2971+0.457426
[81] train-rmse:93.021+0.11452 test-rmse:93.02+0.4559
[84] train-rmse:92.7448+0.114151 test-rmse:92.7437+0.454427
[87] train-rmse:92.4693+0.113771 test-rmse:92.4682+0.452962
```

In [163]:

```
'''Train the xgb model then predict the test data
(3, 400, 0.0045, 0.95)
max_depth,n_trees,eta,subsample'''

xgb_params = {
            'n_trees': 400,
            'max_depth': 3,
            'eta': 0.0045,
            'subsample': 0.95,
            'objective': 'reg:linear',
            'eval_metric': 'rmse',
             }

dtrain = xgb.DMatrix(decomposed_train, actual_y)
dtest = xgb.DMatrix(decomposed_test)

# NOTE: Make sure that the class is labeled 'class' in the data file
num_boost_rounds = 1209
# train model
model = xgb.train(dict(xgb_params, silent=0), dtrain, num_boost_round=num_boost_rounds)
y_pred_train = model.predict(dtrain)
y_pred = model.predict(dtest)
```

```
[23:16:05] WARNING: C:/Jenkins/workspace/xgboost-
win64_release_0.90/src/objective/regression_obj.cu:152: reg:linear is now deprecated in favor of
reg:squarederror.
```

In [13]:

```
#lET'S FIND THE KAGGLE SCORE.
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = model.predict(dtest)
sub.to_csv('submission_Final.csv', index=False)
```

GBDT REGRESSOR

In [11]:

```
GBDT_Regression(scaled_train,scaled_test)
```

```
Fitting 5 folds for each of 20 candidates, totalling 100 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  25 tasks      | elapsed:   18.0s
[Parallel(n_jobs=-1)]: Done 100 out of 100 | elapsed:   46.3s finished
```

```
params : {'subsample': 0.2, 'min_samples_split': 6, 'min_samples_leaf': 4, 'max_features': 0.55,
'max_depth': 9, 'learning_rate': 0.001} and it's test r2 score is 0.10134429031631804 and it's tra
in r2 score is 0.11361554813916537
params : {'subsample': 0.6, 'min_samples_split': 8, 'min_samples_leaf': 10, 'max_features': 0.55,
'max_depth': 4, 'learning_rate': 0.0025} and it's test r2 score is 0.22644101304111536 and it's tr
ain r2 score is 0.236693127402087
params : {'subsample': 0.1, 'min_samples_split': 7, 'min_samples_leaf': 5, 'max_features': 0.7,
'max_depth': 7, 'learning_rate': 0.02} and it's test r2 score is 0.559548307231408 and it's train
r2 score is 0.6152155795220045
params : {'subsample': 0.2, 'min_samples_split': 4, 'min_samples_leaf': 6, 'max_features': 0.4,
'max_depth': 3, 'learning_rate': 0.0025} and it's test r2 score is 0.2188510752513157 and it's tra
in r2 score is 0.22652013499384172
params : {'subsample': 0.5, 'min_samples_split': 2, 'min_samples_leaf': 4, 'max_features': 0.5,
'max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is 0.10056652105706412 and it's tra
```

```
in r2 score is 0.11528242821699752
params : {'subsample': 0.2, 'min_samples_split': 2, 'min_samples_leaf': 3, 'max_features': 0.9,
'max_depth': 4, 'learning_rate': 0.001} and it's test r2 score is 0.10166742258061183 and it's tra
in r2 score is 0.10910141665322062
params : {'subsample': 0.6, 'min_samples_split': 4, 'min_samples_leaf': 5, 'max_features': 0.4,
'max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is 0.09964891993055316 and it's tra
in r2 score is 0.11461506168080768
params : {'subsample': 0.4, 'min_samples_split': 7, 'min_samples_leaf': 9, 'max_features': 0.9,
'max_depth': 2, 'learning_rate': 0.0045} and it's test r2 score is 0.3136472070116266 and it's tra
in r2 score is 0.3188199548491198
params : {'subsample': 0.4, 'min_samples_split': 10, 'min_samples_leaf': 7, 'max_features': 0.3, '
max_depth': 7, 'learning_rate': 0.001} and it's test r2 score is 0.09968981616492785 and it's trai
n r2 score is 0.1109175059326343
params : {'subsample': 0.4, 'min_samples_split': 2, 'min_samples_leaf': 10, 'max_features': 0.4, '
max_depth': 8, 'learning_rate': 0.001} and it's test r2 score is 0.09976755157738629 and it's trai
n r2 score is 0.11158444811982109
params : {'subsample': 0.4, 'min_samples_split': 4, 'min_samples_leaf': 15, 'max_features': 0.3, '
max_depth': 8, 'learning_rate': 0.0045} and it's test r2 score is 0.34264662622643216 and it's tra
in r2 score is 0.3638110939887263
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 6, 'max_features': 0.7,
'max_depth': 2, 'learning_rate': 0.0045} and it's test r2 score is 0.31118621689557296 and it's tr
ain r2 score is 0.31655895869595224
params : {'subsample': 0.1, 'min_samples_split': 9, 'min_samples_leaf': 9, 'max_features': 0.5,
'max_depth': 5, 'learning_rate': 0.0045} and it's test r2 score is 0.3368167035511182 and it's tra
in r2 score is 0.34773353425646125
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 10, 'max_features': 0.4, '
max_depth': 3, 'learning_rate': 0.0045} and it's test r2 score is 0.3362171351942673 and it's
train r2 score is 0.34299121716587144
params : {'subsample': 0.5, 'min_samples_split': 3, 'min_samples_leaf': 20, 'max_features': 0.55,
'max_depth': 4, 'learning_rate': 0.001} and it's test r2 score is 0.09946771780945649 and it's tra
in r2 score is 0.10828382613845125
params : {'subsample': 0.5, 'min_samples_split': 8, 'min_samples_leaf': 3, 'max_features': 0.55,
'max_depth': 7, 'learning_rate': 0.007} and it's test r2 score is 0.43706906495992764 and it's tra
in r2 score is 0.48634457267417536
params : {'subsample': 0.2, 'min_samples_split': 9, 'min_samples_leaf': 4, 'max_features': 0.5,
'max_depth': 2, 'learning_rate': 0.0045} and it's test r2 score is 0.30360814013987153 and it's tr
ain r2 score is 0.31025883888960476
params : {'subsample': 0.4, 'min_samples_split': 8, 'min_samples_leaf': 15, 'max_features': 0.4, '
max_depth': 2, 'learning_rate': 0.02} and it's test r2 score is 0.5514977570507713 and it's train
r2 score is 0.5593872887386564
params : {'subsample': 0.2, 'min_samples_split': 7, 'min_samples_leaf': 3, 'max_features': 0.7,
'max_depth': 7, 'learning_rate': 0.02} and it's test r2 score is 0.5457865665181029 and it's train
r2 score is 0.6450303218902544
params : {'subsample': 0.2, 'min_samples_split': 8, 'min_samples_leaf': 10, 'max_features': 0.5, '
max_depth': 7, 'learning_rate': 0.001} and it's test r2 score is 0.09995657571708036 and it's trai
n r2 score is 0.1096042502506912
Best score: 0.559548307231408
Best params:
learning_rate: 0.02
max_depth: 7
max_features: 0.7
min_samples_leaf: 5
min_samples_split: 7
subsample: 0.1
GBDT best model result : 0.611672103143378
```

<!DOCTYPE html>

MODEL SUMMARY

ATTEMPT 1

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET	LABEL	ABOVE 150 SEC VALUES	[illegible]	[illegible]	[illegible]	[illegible]

3.	MODEL	ENCODING	IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
7.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Mupliple parameters	.65	7.01	.53701
8.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.53901

ATTEMPT 2

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
8.	LASSO REGRESSION MODEL	LABEL ENCODING	REMOVED 12 UNIMPORTANT FEATURES FROM THE DATASET	ALPHA = .9	0.58	7.761	0.51926

ATTEMPT 3

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
9.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .9	0.553	8.29	0.52224
10.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = 400	0.031	12.22	0.12
11.	ELASTICNET REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .7	0.573	8.10	.52685
12.	LASSOLARS MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	NORMALIZE = TRUE	0.555	8.28	.5173
13.	DECISIONTREE REGRESSOR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	0.60	7.86	.54353
14.	SVR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	C Value : 1	8.80	.495	No
15.	XGBOOST MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	--	--	--
16.	GBDT MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	--	.62	.53003

ATTEMPT 4

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
16.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .9	.5521	8.31	0.52215
17.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.031	12.23	-

	MODEL		WITH 130				
7.	ELASTICNET REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .7	0.572	8.12	.52693-
18.	LASSOLARS MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .7	0.59	8.104	.53496-
19.	DECISIONTREE REGRESSOR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	Mutli-Parameters	0.60	7.86	.54356
20.	SVR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	C = .7	0.49	8.8	.42905-
21.	GBDT MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	Multiple parameters	.5921	8.01	.5421-

ATTEMPT 5

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
21.	LASSO MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .09	0.58	8.04	.53174-
22.	RIDGE MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.035	12.20	--
23.	ELASTICNET MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.577	8.08	.52921
24.	LARSLASSO MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.566	8.17	.52329
25.	DECISION TREE MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	Multi parameters	0.59	8.17	.54356
26.	XGBOOST MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	Multi parameters	0.62	7.52	.5356
25.	GBDT REGRESSOR	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	Multi parameters	NO	NO	NO

ATTEMPT 6

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
27.	LASSO MODEL	LABEL ENCODING without ID feature	iMPUTED 265.32 ONLY WITH 130	ALPHA = .09	0.58	8.00	.53370
28.	DECISION TREE MODEL	LABEL ENCODING without ID feature	iMPUTED 265.32 ONLY WITH 130	MULTIPARAMETERS	0.59	7.88	.54218
30.	LASSOLARS MODEL	LABEL ENCODING without ID feature	iMPUTED 265.32 ONLY WITH 130	NOTMALIZED = TRUE	0.54	8.37	.506

ATTEMPT 7

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
31.	LASSO REGRESSION	DECOMPOSED FEATURES	iMPUTED 265.32 ONLY WITH 130	Multi parameters	.58	8.04	.5262
32.	DECISION TREE	DECOMPOSED FEATURES	iMPUTED 265.32 ONLY WITH 130	Multi parameters	.60	7.812	.53264
			iMPUTED				

34.	XGBOOST	DECOMPOSED FEATURES	IMPUTED 265.32 ONLY WITH 130	Multi parameters	--	8.002	.54167
34.	GBDT REGRESSOR	DECOMPOSED FEATURES	iMPUTED 265.32 ONLY WITH 130	Multi parameters	--	8.002	.53228

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34">

Final Analysis.

My Thought Process: From above i am choosing ATTEMPT 4 and ATTEMPT 7 as the best attempt, now, i will apply ensemble models as per the architecture shown in the starting. The one gives less fluctuation in the CV test score with highest means test R^2 Score,i will choose that one.I will check for LassoLars,DecisionTree,Lasso Regression,GBDT and check the best combination which give best results.

5. Machine Learning Model Architecture

<img src = "https://i.imgur.com/QRO4Niv.png" ></img>

1.Stacking Models

In [164]:

```
class StackingEstimator(BaseEstimator, TransformerMixin):
    # refered from the https://www.kaggle.com/hakeem/stacked-then-averaged-models-0-5697?
scriptVersionId=1252368 kernel
    def __init__(self, estimator):
        self.estimator = estimator


    def fit(self, X, y=None, **fit_params):
        self.estimator.fit(X, y, **fit_params)
        return self

    def transform(self, X):
        X = check_array(X)
        X_transformed = np.copy(X)
        # add class probabilities as a synthetic feature
        if issubclass(self.estimator.__class__, ClassifierMixin) and hasattr(self.estimator, 'predi
ct_proba'):
            X_transformed = np.hstack((self.estimator.predict_proba(X), X))
        # add class prodiction as a synthetic feature
        X_transformed = np.hstack((np.reshape(self.estimator.predict(X), (-1, 1)), X_transformed))
        return X_transformed

def stacking_classifier_selection(classifier_1,classifier_2,Estimators_Trial,check):
    """This function is writte to select the best Stacking combination of the model as we have sel
ected
    LassoLarsCV,DecisionTree,Lasso Regression,GBDT, ElasticNet"""
    graph_of_estimator_train = dict()
    graph_of_estimator_test = dict()
    for classifier in  Estimators_Trial:
        # if else conditon to place different model at diffeent location in the stacking.
        #If check ==3 i will place differetn models at last vice versa.
        if (check == 3):
            stacked_pipeline = make_pipeline(
                StackingEstimator(estimator= classifier_1),
                StackingEstimator(estimator=classifier_2),
                classifier
            )
        elif(check == 2) :
            stacked_pipeline = make_pipeline(
                StackingEstimator(estimator= classifier_1),
                StackingEstimator(estimator=classifier),
                classifier_2
            )
        else:
            stacked_pipeline = make_pipeline(
```

```
                StackingEstimator(estimator= classifier),
                StackingEstimator(estimator=classifier_1),
                classifier_2
            )

        stacked_pipeline.fit(scaled_train, actual_y)

        # cross vlaidation for the particular stacked model.
        Scores = cross_validate(stacked_pipeline, scaled_train, actual_y, cv=5,scoring=('r2'),\
                                return_train_score=True)

        used_clf = str(classifier).split("(",1)[0]
        graph_of_estimator_train.update({used_clf: np.mean(Scores['train_score'])})
        graph_of_estimator_test.update({used_clf: np.mean(Scores['test_score'])})

        print(f" Train score for classifier {used_clf} is {Scores['train_score']}")
        print(f"Test score for classifier {used_clf} is {Scores['test_score']}")

    plt.figure(figsize=(15,8))
    plt.scatter([i for i in graph_of_estimator_train.keys()], [i for i in graph_of_estimator_train.
values()],c="blue",s = 100,label = "Train R^2 Loss")
    plt.scatter([i for i in graph_of_estimator_test.keys()], [i for i in graph_of_estimator_test.va
lues()],c="orange",s = 100,label = "Test R^2 Loss")
    plt.legend()
    plt.grid()
    plt.title("Final analysis on the basis of test and train loss on the stacking model.")
    plt.xlabel("Model Names")
    plt.ylabel("Loss")
    # add annoatation in the grapgh
    for key,value in  [i for i in graph_of_estimator_train.items()]:
        plt.annotate(value,(key,value+.006))

    for key,value in  [i for i in graph_of_estimator_test.items()]:
        plt.annotate(value,(key,value+.006))
    plt.show()
```

Checking the combination of the stacking models.

1. Used only 2 models in the stack.

In [123]:

```
train_dict = dict()
test_dict = dict()
stacked_pipeline = make_pipeline(
                StackingEstimator(estimator= ElasticNet(alpha=.7, fit_intercept=True, normalize=Fal
se, max_iter=100,\
                            random_state=23)),
                StackingEstimator(estimator=DecisionTreeRegressor(ccp_alpha=0.0, criterion='friedma
n_mse', max_depth=3,\
                      max_features=None, max_leaf_nodes=50,\
                      min_impurity_decrease=0.0, min_impurity_split=None,\
                      min_samples_leaf=1, min_samples_split=5,\
                      min_weight_fraction_leaf=0.0, presort='deprecated',\
                      random_state=2, splitter='best')),
                LassoLarsCV(normalize=True,cv=5)
)

stacked_pipeline.fit(scaled_train, actual_y)
Scores = cross_validate(stacked_pipeline, scaled_train, actual_y, cv=5,scoring=('r2'),\
                                return_train_score=True)

print(f" Train score for classifier {used_clf} is {Scores['train_score']}")
print(f" Test score for classifier {used_clf} is {Scores['test_score']}")
print(f" Test means score : {np.mean(Scores['test_score'])}")
print(f" train means score : {np.mean(Scores['train_score'])}")
train_dict.update({"2" : np.mean(Scores['train_score'])})
test_dict.update({"2" : np.mean(Scores['test_score'])})
```

```
 Train score for classifier Lasso is [0.60005876 0.62362594 0.6121798  0.61445493 0.59282851]
 Test score for classifier Lasso is [0.36771411 0.534609   0.59319466 0.53188638 0.62541117]
 Test means score : 0.5305630641119412
```

```
train means score : 0.6086295849932142
```

2. Used only 3 models in the stack.

In [124]:

```
stacked_pipeline = make_pipeline(
                StackingEstimator(estimator=LassoLarsCV(normalize=True,cv=5)),
                StackingEstimator(estimator=DecisionTreeRegressor(ccp_alpha=0.0, criterion='friedma
n_mse', max_depth=3,\
                      max_features=None, max_leaf_nodes=50,\
                      min_impurity_decrease=0.0, min_impurity_split=None,\
                      min_samples_leaf=1, min_samples_split=5,\
                      min_weight_fraction_leaf=0.0, presort='deprecated',\
                      random_state=2, splitter='best')),
                StackingEstimator(estimator=GradientBoostingRegressor(alpha=0.9, criterion='friedma
n_mse', init=None,learning_rate=0.1,\
                          loss='ls', max_depth=3,max_features=0.55, max_leaf_nodes=None,\
                          min_impurity_decrease=0.0, min_impurity_split=None,\
                          min_samples_leaf=14, min_samples_split=16,\
                          min_weight_fraction_leaf=0.0, n_estimators=100,\
                          n_iter_no_change=None, presort='auto',\
                          random_state=19, subsample=0.8, tol=0.0001,\
                          validation_fraction=0.1, verbose=0, warm_start=False)),
                LassoLarsCV(normalize=True,cv=5)
)

stacked_pipeline.fit(scaled_train, actual_y)
Scores = cross_validate(stacked_pipeline, scaled_train, actual_y, cv=5,scoring=('r2'),\
                                return_train_score=True)

print(f" Train score for classifier {used_clf} is {Scores['train_score']}")
print(f" Test score for classifier {used_clf} is {Scores['test_score']}")
print(f" Test means score : {np.mean(Scores['test_score'])}")
print(f" train means score : {np.mean(Scores['train_score'])}")
train_dict.update({"3" : np.mean(Scores['train_score'])})
test_dict.update({"3" : np.mean(Scores['test_score'])})
```

```
Train score for classifier Lasso is [0.65703562 0.66765175 0.65523342 0.66447075 0.63707712]
Test score for classifier Lasso is [0.50075585 0.52448095 0.59455551 0.54632118 0.6482002 ]
Test means score : 0.5628627392109726
train means score : 0.6562937331987995
```

3. Used only 4 models in the stack.

In [125]:

```
stacked_pipeline = make_pipeline(
                StackingEstimator(estimator= ElasticNet(alpha=.7, fit_intercept=True, normalize=Fal
se, max_iter=100,\
                            random_state=23)),
                StackingEstimator(estimator=DecisionTreeRegressor(ccp_alpha=0.0, criterion='friedma
n_mse', max_depth=3,\
                      max_features=None, max_leaf_nodes=50,\
                      min_impurity_decrease=0.0, min_impurity_split=None,\
                      min_samples_leaf=1, min_samples_split=5,\
                      min_weight_fraction_leaf=0.0, presort='deprecated',\
                      random_state=2, splitter='best')),
                StackingEstimator(estimator=LassoLarsCV(normalize=True,cv=5)),
                StackingEstimator(estimator=GradientBoostingRegressor(alpha=0.9, criterion='friedma
n_mse', init=None,learning_rate=0.1,\
                          loss='ls', max_depth=3,max_features=0.55, max_leaf_nodes=None,\
                          min_impurity_decrease=0.0, min_impurity_split=None,\
                          min_samples_leaf=14, min_samples_split=16,\
                          min_weight_fraction_leaf=0.0, n_estimators=100,\
                          n_iter_no_change=None, presort='auto',\
                          random_state=19, subsample=0.8, tol=0.0001,\
                          validation_fraction=0.1, verbose=0, warm_start=False)),
                LassoLarsCV(normalize=True,cv=5)
)

stacked_pipeline.fit(scaled_train, actual_y)
```

```
Scores = cross_validate(stacked_pipeline, scaled_train, actual_y, cv=5,scoring=('r2'),\
                                return_train_score=True)

print(f" Train score for classifier {used_clf} is {Scores['train_score']}")
print(f" Test score for classifier {used_clf} is {Scores['test_score']}")
print(f" Test means score : {np.mean(Scores['test_score'])}")
print(f" train means score : {np.mean(Scores['train_score'])}")
train_dict.update({"4" : np.mean(Scores['train_score'])})
test_dict.update({"4" : np.mean(Scores['test_score'])})
```

```
 Train score for classifier Lasso is [0.66870655 0.67547661 0.67394621 0.66705249 0.66180114]
 Test score for classifier Lasso is [0.35940666 0.52610991 0.59336244 0.54563002 0.61918798]
 Test means score : 0.5287394029923195
 train means score : 0.6693966011952075
```

4. Used only 5 models in the stack.

In [126]:

```
stacked_pipeline = make_pipeline(
                StackingEstimator(estimator= ElasticNet(alpha=.7, fit_intercept=True, normalize=Fal
se, max_iter=100,\
                            random_state=23)),
                StackingEstimator(estimator=DecisionTreeRegressor(ccp_alpha=0.0, criterion='friedma
n_mse', max_depth=3,\
                      max_features=None, max_leaf_nodes=50,\
                      min_impurity_decrease=0.0, min_impurity_split=None,\
                      min_samples_leaf=1, min_samples_split=5,\
                      min_weight_fraction_leaf=0.0, presort='deprecated',\
                      random_state=2, splitter='best')),
                StackingEstimator(estimator=LassoLarsCV(normalize=True,cv=5)),
                StackingEstimator(estimator=GradientBoostingRegressor(alpha=0.9, criterion='friedma
n_mse', init=None,learning_rate=0.1,\
                          loss='ls', max_depth=3,max_features=0.55, max_leaf_nodes=None,\
                          min_impurity_decrease=0.0, min_impurity_split=None,\
                          min_samples_leaf=14, min_samples_split=16,\
                          min_weight_fraction_leaf=0.0, n_estimators=100,\
                          n_iter_no_change=None, presort='auto',\
                          random_state=19, subsample=0.8, tol=0.0001,\
                          validation_fraction=0.1, verbose=0, warm_start=False)),
                StackingEstimator(estimator= Lasso(alpha=.09, fit_intercept=True, normalize=False,r
andom_state=23)),
                LassoLarsCV(normalize=True,cv=5)
)

stacked_pipeline.fit(scaled_train, actual_y)
Scores = cross_validate(stacked_pipeline, scaled_train, actual_y, cv=5,scoring=('r2'),\
                                return_train_score=True)

print(f" Train score for classifier {used_clf} is {Scores['train_score']}")
print(f" Test score for classifier {used_clf} is {Scores['test_score']}")
print(f" Test means score : {np.mean(Scores['test_score'])}")
print(f" train means score : {np.mean(Scores['train_score'])}")
train_dict.update({"5" : np.mean(Scores['train_score'])})
test_dict.update({"5" : np.mean(Scores['test_score'])})
```

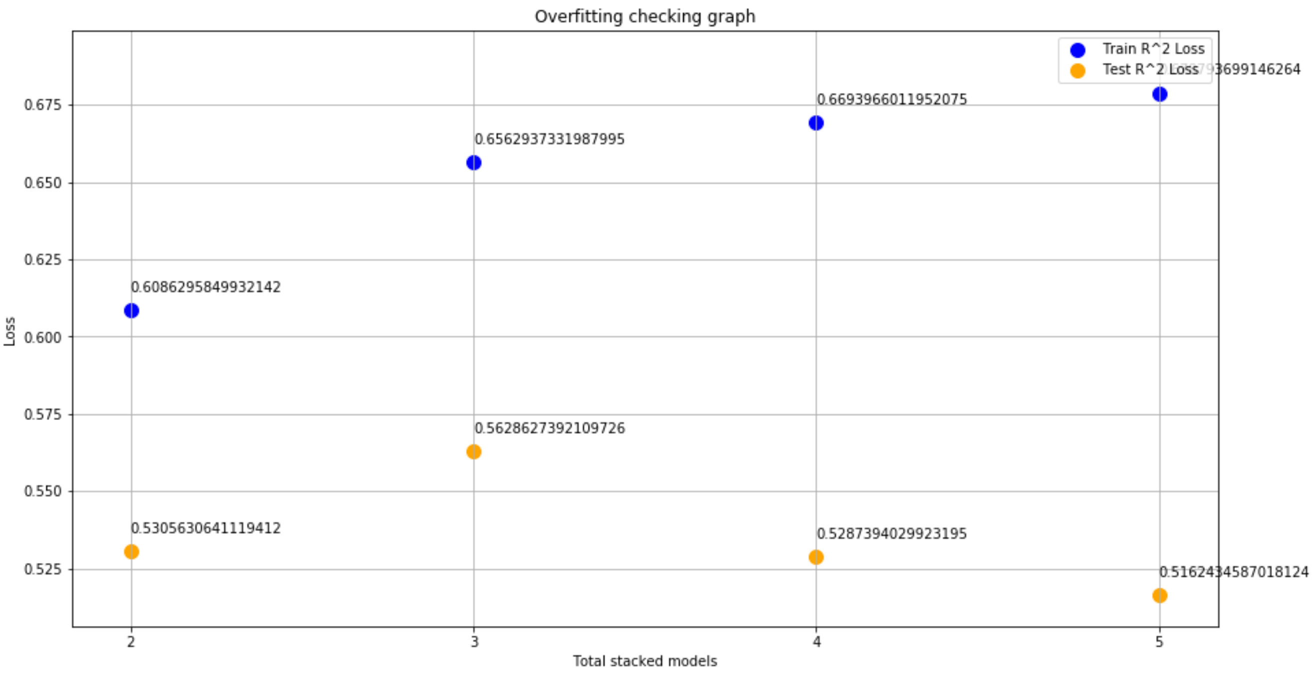
```
 Train score for classifier Lasso is [0.67038063 0.68823421 0.68287371 0.68527464 0.66720531]
 Test score for classifier Lasso is [0.3491831  0.50938502 0.58226185 0.53109305 0.60929428]
 Test means score : 0.5162434587018124
 train means score : 0.678793699146264
```

Creating a plot to see the how many model should i use in the stack and answer came out as : 2

In [127]:

```
plt.figure(figsize=(15,8))
plt.scatter([i for i in train_dict.keys()], [i for i in train_dict.values()],c="blue",s = 100,label
= "Train R^2 Loss")
plt.scatter([i for i in test_dict.keys()], [i for i in test_dict.values()],c="orange",s = 100,label
= "Test R^2 Loss")
```

```
plt.legend()
plt.grid()
plt.title("Overfitting checking graph")
plt.xlabel("Total stacked models")
plt.ylabel("Loss")
for key,value in  [i for i in train_dict.items()]:
    plt.annotate(value,(key,value+.006))

for key,value in  [i for i in test_dict.items()]:
    plt.annotate(value,(key,value+.006))
plt.show()
```



<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process:I will take 2 classifier as my final stacking classifier number because from the graph o can see thaat my model is going toward overfitting as i am increasing the number of model in the stack.

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process: Now, I know i have to take only 2 classifer in the stack but which classifier i don't know so for that i wil do some analysis to find out which combition will give me the best result. Please see below........

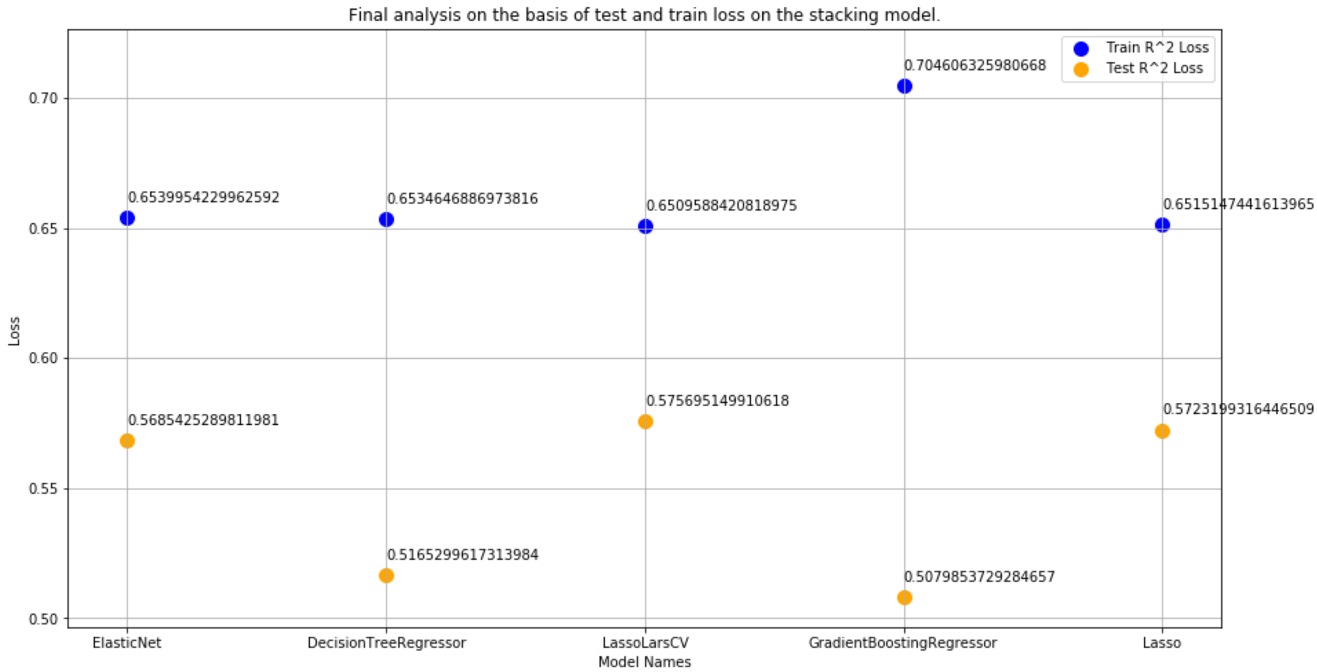
1st Combination

In [165]:

```
# Using the stacking techniques to provide robustness to the model
# List contain all the wel perfromed models......
Estimators_Trial = [

ElasticNet(alpha=.7, fit_intercept=True, normalize=False, max_iter=100,\
                            random_state=23),

DecisionTreeRegressor(ccp_alpha=0.0, criterion='friedman_mse', max_depth=3,\
                      max_features=None, max_leaf_nodes=50,\
                      min_impurity_decrease=0.0, min_impurity_split=None,\
                      min_samples_leaf=1, min_samples_split=5,\
                      min_weight_fraction_leaf=0.0, presort='deprecated',\
                      random_state=2, splitter='best'),

LassoLarsCV(normalize=True,cv=5),
```

```
GradientBoostingRegressor(alpha=0.9, criterion='friedman_mse', init=None,learning_rate=0.1,\
                          loss='ls', max_depth=3,max_features=0.55, max_leaf_nodes=None,\
                          min_impurity_decrease=0.0, min_impurity_split=None,\
                          min_samples_leaf=14, min_samples_split=16,\
                          min_weight_fraction_leaf=0.0, n_estimators=100,\
                          n_iter_no_change=None, presort='auto',\
                          random_state=19, subsample=0.8, tol=0.0001,\
                          validation_fraction=0.1, verbose=0, warm_start=False),

Lasso(alpha=.9, fit_intercept=True, normalize=False,random_state=23)

]

# fixing 1 model and 2nd model and changing the third model.
classifier_1 = LassoLarsCV(normalize=True,cv=5)
classifier_2 = GradientBoostingRegressor(alpha=0.9, criterion='friedman_mse', init=None,
                                  learning_rate=0.1, loss='ls', max_depth=3,
                                  max_features=0.55, max_leaf_nodes=None,
                                  min_impurity_decrease=0.0, min_impurity_split=None,
                                  min_samples_leaf=14, min_samples_split=16,
                                  min_weight_fraction_leaf=0.0, n_estimators=100,
                                  n_iter_no_change=None, presort='auto',
                                  random_state=19, subsample=0.8, tol=0.0001,
                                  validation_fraction=0.1, verbose=0, warm_start=False)

stacking_classifier_selection(classifier_1,classifier_2,Estimators_Trial,3)
```

```
 Train score for classifier ElasticNet is [0.644633   0.66716707 0.65587328 0.6661544  0.63614937]
Test score for classifier ElasticNet is [0.54867385 0.52659913 0.5922376  0.53585898 0.63934308]
 Train score for classifier DecisionTreeRegressor is [0.64210422 0.66183976 0.65470473 0.6685238
0.64015094]
Test score for classifier DecisionTreeRegressor is [0.34202329 0.49880468 0.58455599 0.53313167 0.
62413418]
 Train score for classifier LassoLarsCV is [0.63993944 0.66529387 0.65302112 0.66253871
0.63400107]
Test score for classifier LassoLarsCV is [0.56529021 0.53057411 0.59712369 0.53976592 0.64572182]
 Train score for classifier GradientBoostingRegressor is [0.69427839 0.70961515 0.71001311
0.72340152 0.68572345]
Test score for classifier GradientBoostingRegressor is [0.32344488 0.50307215 0.56651682
0.51681967 0.63007334]
 Train score for classifier Lasso is [0.64238253 0.66456724 0.65345209 0.66346653 0.63370532]
Test score for classifier Lasso is [0.55757997 0.5288765  0.59483693 0.53882437 0.64148189]
```



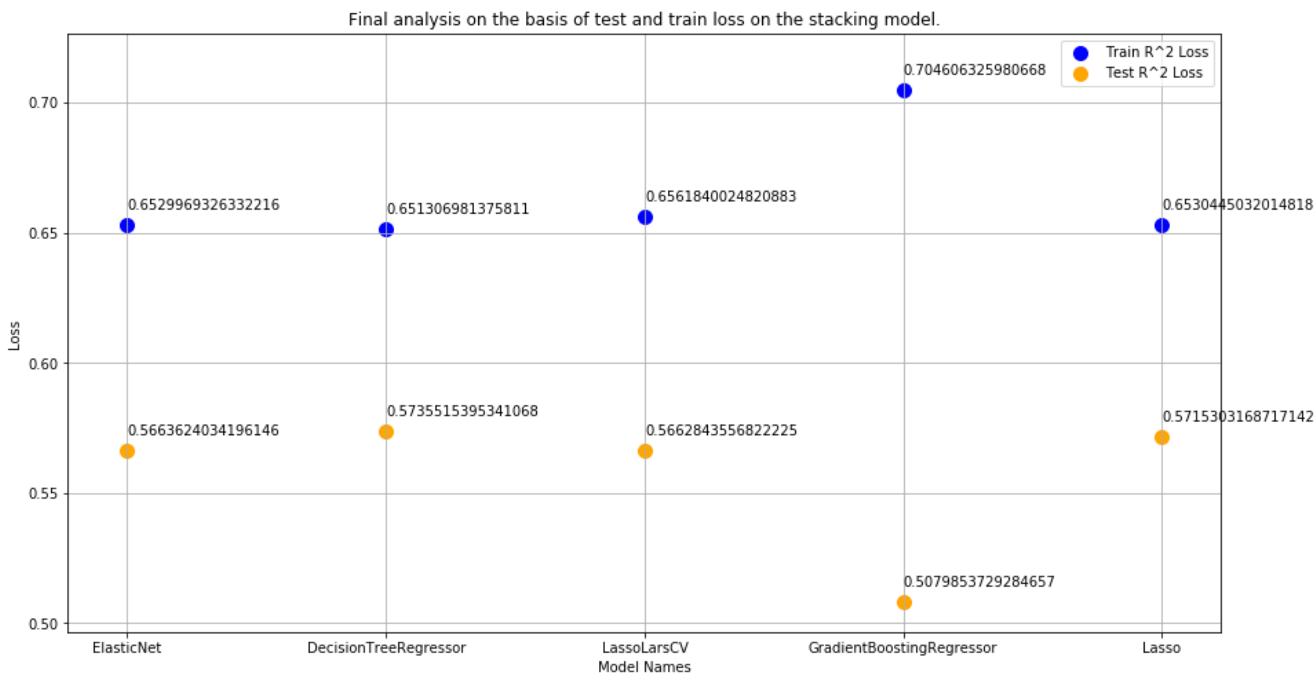
<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process:From above i will choose : Difference between train and test model is .075

2nd Combination

In [166]:

```
stacking_classifier_selection(classifier_1,classifier_2,Estimators_Trial,2)
```

```
 Train score for classifier ElasticNet is [0.64326926 0.66643177 0.65310706 0.66358085 0.63859572]
Test score for classifier ElasticNet is [0.50864711 0.53005955 0.59428007 0.54751227 0.65131301]
 Train score for classifier DecisionTreeRegressor is [0.6418378  0.66545945 0.65271906 0.66264638
0.63387221]
Test score for classifier DecisionTreeRegressor is [0.55286135 0.52425833 0.59501907 0.54657009 0.
64904886]
 Train score for classifier LassoLarsCV is [0.64892302 0.6729331  0.65795365 0.66423177
0.63687848]
Test score for classifier LassoLarsCV is [0.51577762 0.53114127 0.59490853 0.54243815 0.64715621]
 Train score for classifier GradientBoostingRegressor is [0.69427839 0.70961515 0.71001311
0.72340152 0.68572345]
Test score for classifier GradientBoostingRegressor is [0.32344488 0.50307215 0.56651682
0.51681967 0.63007334]
 Train score for classifier Lasso is [0.64471176 0.66736434 0.6546276  0.66327958 0.63523924]
Test score for classifier Lasso is [0.53430037 0.52805662 0.59649993 0.54347527 0.65531939]
```



<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process:From above i can minimum see difference between train and test is .078

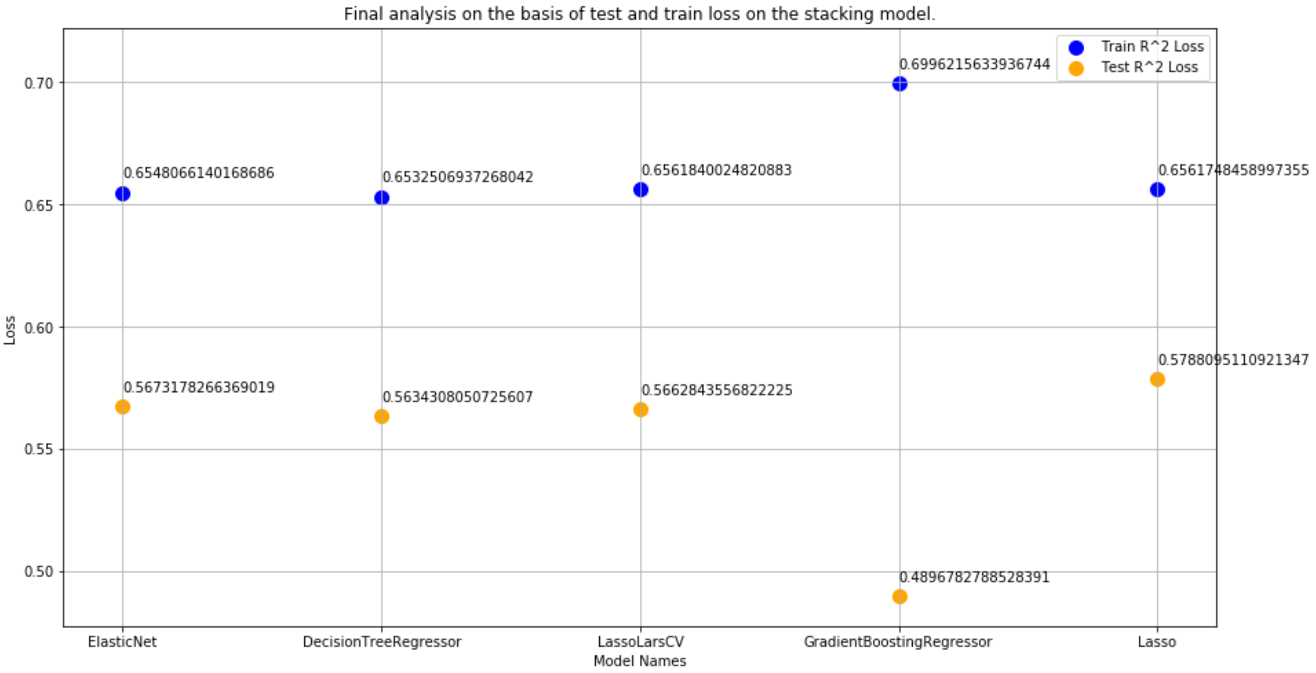
3rd Combination

In [167]:

```
stacking_classifier_selection(classifier_1,classifier_2,Estimators_Trial,1)
```

```
 Train score for classifier ElasticNet is [0.64478322 0.66450951 0.65529528 0.66726113 0.64218394]
Test score for classifier ElasticNet is [0.51767629 0.52983494 0.59525695 0.54897947 0.64484148]
 Train score for classifier DecisionTreeRegressor is [0.65296001 0.66653837 0.65119227 0.66035835
0.63520446]
Test score for classifier DecisionTreeRegressor is [0.50319798 0.52890126 0.59380155 0.53812751 0.
65312572]
 Train score for classifier LassoLarsCV is [0.64892302 0.6729331  0.65795365 0.66423177
0.63687848]
Test score for classifier LassoLarsCV is [0.51577762 0.53114127 0.59490853 0.54243815 0.64715621]
 Train score for classifier GradientBoostingRegressor is [0.69522846 0.70450517 0.69980001
```

```
 Train score for classifier GradientBoostingRegressor is [0.69522846 0.70430517 0.69980001
0.7047671  0.69380707]
Test score for classifier GradientBoostingRegressor is [0.24645715 0.5055362  0.55905672
0.52377394 0.61356738]
 Train score for classifier Lasso is [0.64968428 0.67196565 0.6573922  0.66193744 0.63989465]
Test score for classifier Lasso is [0.57131564 0.52961212 0.59191852 0.5466692  0.65453207]
```



<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGI2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> My Thought Process:From above i see difference between train and test is .078 so i will choose .075 model combination now which is first combination.

<img src = "[https://i.imgur.com/5kApgf6.png">](https://i.imgur.com/5kApgf6.png)

Final Model

In [168]:

```
# Using the stacking techniques to provide robustness to the model
stacked_pipeline = make_pipeline(
    StackingEstimator(estimator=LassoLarsCV(normalize=True,cv=5)),
    StackingEstimator(estimator=GradientBoostingRegressor(alpha=0.9, criterion='friedman_mse',
init=None,learning_rate=0.1,\
                          loss='ls', max_depth=3,max_features=0.55, max_leaf_nodes=None,\
                          min_impurity_decrease=0.0, min_impurity_split=None,\
                          min_samples_leaf=14, min_samples_split=16,\
                          min_weight_fraction_leaf=0.0, n_estimators=100,\
                          n_iter_no_change=None, presort='auto',\
                          random_state=19, subsample=0.8, tol=0.0001,\
                          validation_fraction=0.1, verbose=0, warm_start=False)),
    LassoLarsCV(normalize=True,cv=5)
)
stacked_pipeline.fit(train, actual_y)
results = stacked_pipeline.predict(test)
```

In [169]:

```
'''Average the preditionon test data  of both models then save it on a csv file'''
results = stacked_pipeline.predict(scaled_test)
sub = pd.DataFrame()
i = .62
sub['ID'] = test['ID']
sub['y'] = y_pred*(1-i) + results*i
sub.to_csv('submission_Final.csv', index=False)
# i was getting public score 0.55438 for .62 so i choosed this.
```

2. Voting Regressor

In [129]:

```
from sklearn.ensemble import VotingRegressor

r1 = LassoLarsCV(fit_intercept=True, verbose=True, max_iter=500, normalize=True, precompute='auto',
\
                        cv=5, max_n_alphas=1000, n_jobs=None, eps=2.220446049250313e-16, copy_X=Tru
, positive=False)

r2 = GradientBoostingRegressor(alpha=0.9, criterion='friedman_mse', init=None,
                          learning_rate=0.1, loss='ls', max_depth=3,
                          max_features=0.55, max_leaf_nodes=None,
                          min_impurity_decrease=0.0, min_impurity_split=None,
                          min_samples_leaf=14, min_samples_split=16,
                          min_weight_fraction_leaf=0.0, n_estimators=100,
                          n_iter_no_change=None, presort='auto',
                          random_state=19, subsample=0.8, tol=0.0001,
                          validation_fraction=0.1, verbose=0, warm_start=False)
r3 = ElasticNet(alpha=.7, fit_intercept=True, normalize=False, max_iter=100,\
                            random_state=23)
r4 = DecisionTreeRegressor(ccp_alpha=0.0, criterion='friedman_mse', max_depth=3,\
                      max_features=None, max_leaf_nodes=50,\
                      min_impurity_decrease=0.0, min_impurity_split=None,\
                      min_samples_leaf=1, min_samples_split=5,\
                      min_weight_fraction_leaf=0.0, presort='deprecated',\
                      random_state=2, splitter='best')

Voting_regressor = VotingRegressor([('LR', r1), ('GR', r2), ('RR', r3),('DT',r4)])

clf = Voting_regressor.fit(scaled_train,actual_y)
clf.fit(scaled_train, actual_y)

Scores = cross_validate(clf, scaled_train, actual_y, cv=5,scoring=('r2'),\
                                return_train_score=True)

print(f" Train score for classifier {used_clf} is {Scores['train_score']}")
print(f" Test score for classifier {used_clf} is {Scores['test_score']}")
print(f" Test means score : {np.mean(Scores['test_score'])}")
print(f" train means score : {np.mean(Scores['train_score'])}")
train_dict.update({"3" : np.mean(Scores['train_score'])})
test_dict.update({"3" : np.mean(Scores['test_score'])})
```

```
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   5 out of   5 | elapsed:    0.3s finished
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   5 out of   5 | elapsed:    0.4s finished
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   5 out of   5 | elapsed:    0.3s finished
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   5 out of   5 | elapsed:    0.3s finished
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   5 out of   5 | elapsed:    0.3s finished
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   5 out of   5 | elapsed:    0.4s finished
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   5 out of   5 | elapsed:    0.3s finished
```

```
 Train score for classifier Lasso is [0.58148784 0.60773365 0.59440982 0.60827631 0.57725532]
 Test score for classifier Lasso is [0.58463771 0.5179664  0.58388747 0.51956451 0.62839563]
 Test means score : 0.5668903449792282
 train means score : 0.5938325892878066
```

<img src = "https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcQmpsaHLkv3d85Eamq-zGl2K2cA4d3xptRbr4XGZ79R9pl6sn2n" width="60" height="34"> Voting Regressor i can see is giving good result, CV score is not fluctuating that much and train score is good. but when i check the above the voting regressor on kaggle public score, it is not giving not result. Private score : .53201

7.Deep Learning Model Architecture

In [0]:

```
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense 
from tensorflow.keras.layers import Dropout
from tensorflow.keras.layers import BatchNormalization
from tensorflow.keras import backend
import os

input_dim = 437
output_dim = 1
batch_size = 5
epochs = 50
model_adam = Sequential()

model_adam.add(Dense(500, activation='relu', input_shape=(input_dim,)))

model_adam.add(Dropout(0.2))

model_adam.add(Dense(450, activation='relu'))

model_adam.add(Dropout(0.5))

model_adam.add(Dense(300, activation='relu'))

model_adam.add(Dropout(0.5))

model_adam.add(Dense(100, activation='relu'))

model_adam.add(Dense(10, activation='relu'))

model_adam.add(Dense(output_dim))
```

In [55]:

```
model_adam.summary()
```

```
Model: "sequential_8"
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
dense_38 (Dense)             (None, 500)               219000    
_________________________________________________________________
dropout_22 (Dropout)         (None, 500)               0         
_________________________________________________________________
dense_39 (Dense)             (None, 450)               225450    
_________________________________________________________________
dropout_23 (Dropout)         (None, 450)               0         
_________________________________________________________________
dense_40 (Dense)             (None, 300)               135300    
_________________________________________________________________
dropout_24 (Dropout)         (None, 300)               0         
_________________________________________________________________
dense_41 (Dense)             (None, 100)               30100     
_________________________________________________________________
dense_42 (Dense)             (None, 10)                1010      
_________________________________________________________________
dense_43 (Dense)             (None, 1)                 11        
=================================================================
Total params: 610,871
Trainable params: 610,871
Non-trainable params: 0
_________________________________________________________________
```

In [0]:

```
def rmse(y_true, y_pred):
 return backend.sqrt(backend.mean(backend.square(y_pred - y_true), axis=-1))
```

```python
def plt_dynamic(x, vy, ty, ax, colors=['b']):
    ax.plot(x, vy, 'b', label="Validation Loss")
    ax.plot(x, ty, 'r', label="Train Loss")
    plt.legend()
    plt.grid()
    fig.canvas.draw()

def r2_keras(y_true, y_pred):
    SS_res =  backend.sum(backend.square(y_true - y_pred)) 
    SS_tot = backend.sum(backend.square(y_true - backend.mean(y_true))) 
    return -( 1 - SS_res/(SS_tot) )
```

In [56]:

```python
model_adam.compile(optimizer='adam', loss=[r2_keras], metrics=[rmse,r2_keras])

checkpoint_path = "/content/gdrive/My Drive/SelfCaseStudy/train/attempt_1/cp.ckpt"
checkpoint_dir = os.path.dirname(checkpoint_path)
# Create checkpoint callback
cp_callback = tensorflow.keras.callbacks.ModelCheckpoint(checkpoint_path,save_best_only=True,\
                                                         save_weights_only=False ,monitor='val_r2_keras',m
e= "max",\
                                                         verbose=1)


model = model_adam.fit(decomposed_train, actual_y, batch_size=batch_size , verbose = 2, epochs=300,
callbacks=[cp_callback], validation_split=0.2)
```

```
Train on 3367 samples, validate on 842 samples
Epoch 1/300

Epoch 00001: val_r2_keras improved from -inf to -3.89222, saving model to /content/gdrive/My 
Drive/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 5s - loss: 35.3902 - rmse: 35.3902 - r2_keras: -5.5299e+01 - val_loss: 15.5164 - val_r
mse: 15.5164 - val_r2_keras: -3.8922e+00
Epoch 2/300

Epoch 00002: val_r2_keras did not improve from -3.89222
3367/3367 - 3s - loss: 18.5720 - rmse: 18.5720 - r2_keras: -7.3997e+00 - val_loss: 25.9530 - val_r
mse: 25.9530 - val_r2_keras: -1.1422e+01
Epoch 3/300

Epoch 00003: val_r2_keras improved from -3.89222 to -1.59816, saving model to /content/gdrive/My D
rive/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 2s - loss: 18.2641 - rmse: 18.2641 - r2_keras: -1.1674e+01 - val_loss: 10.0039 - val_r
mse: 10.0039 - val_r2_keras: -1.5982e+00
Epoch 4/300

Epoch 00004: val_r2_keras did not improve from -1.59816
3367/3367 - 3s - loss: 17.1177 - rmse: 17.1177 - r2_keras: -6.5093e+00 - val_loss: 20.7584 - val_r
mse: 20.7584 - val_r2_keras: -9.1337e+00
Epoch 5/300

Epoch 00005: val_r2_keras did not improve from -1.59816
3367/3367 - 3s - loss: 17.6950 - rmse: 17.6950 - r2_keras: -7.6040e+00 - val_loss: 10.1743 - val_r
mse: 10.1743 - val_r2_keras: -1.6175e+00
Epoch 6/300

Epoch 00006: val_r2_keras did not improve from -1.59816
3367/3367 - 3s - loss: 16.9124 - rmse: 16.9124 - r2_keras: -5.3069e+00 - val_loss: 19.3339 - val_r
mse: 19.3339 - val_r2_keras: -8.6793e+00
Epoch 7/300

Epoch 00007: val_r2_keras did not improve from -1.59816
3367/3367 - 3s - loss: 16.9283 - rmse: 16.9283 - r2_keras: -6.6761e+00 - val_loss: 8.3849 - val_rm
se: 8.3849 - val_r2_keras: -2.5654e+00
Epoch 8/300

Epoch 00008: val_r2_keras did not improve from -1.59816
3367/3367 - 2s - loss: 17.0539 - rmse: 17.0539 - r2_keras: -6.1683e+00 - val_loss: 15.3760 - val_r
mse: 15.3760 - val_r2_keras: -4.8792e+00
Epoch 9/300
```

```
Epoch 00009: val_r2_keras improved from -1.59816 to -0.52644, saving model to /content/gdrive/My Drive/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 3s - loss: 16.4405 - rmse: 16.4405 - r2_keras: -5.3613e+00 - val_loss: 8.0534 - val_rmse: 8.0534 - val_r2_keras: -5.2644e-01
Epoch 10/300

Epoch 00010: val_r2_keras did not improve from -0.52644
3367/3367 - 3s - loss: 15.5167 - rmse: 15.5167 - r2_keras: -4.2993e+00 - val_loss: 8.4373 - val_rmse: 8.4373 - val_r2_keras: -7.9142e-01
Epoch 11/300

Epoch 00011: val_r2_keras did not improve from -0.52644
3367/3367 - 3s - loss: 16.1707 - rmse: 16.1707 - r2_keras: -5.3042e+00 - val_loss: 8.9540 - val_rmse: 8.9540 - val_r2_keras: -1.2997e+00
Epoch 12/300

Epoch 00012: val_r2_keras did not improve from -0.52644
3367/3367 - 2s - loss: 16.2435 - rmse: 16.2435 - r2_keras: -4.7972e+00 - val_loss: 15.4001 - val_rmse: 15.4001 - val_r2_keras: -3.6280e+00
Epoch 13/300

Epoch 00013: val_r2_keras did not improve from -0.52644
3367/3367 - 3s - loss: 15.8345 - rmse: 15.8345 - r2_keras: -5.5327e+00 - val_loss: 8.2375 - val_rmse: 8.2375 - val_r2_keras: -1.0570e+00
Epoch 14/300

Epoch 00014: val_r2_keras did not improve from -0.52644
3367/3367 - 3s - loss: 15.3587 - rmse: 15.3588 - r2_keras: -4.7421e+00 - val_loss: 16.2207 - val_rmse: 16.2207 - val_r2_keras: -3.6115e+00
Epoch 15/300

Epoch 00015: val_r2_keras did not improve from -0.52644
3367/3367 - 3s - loss: 15.7854 - rmse: 15.7854 - r2_keras: -5.5171e+00 - val_loss: 22.2169 - val_rmse: 22.2169 - val_r2_keras: -7.4657e+00
Epoch 16/300

Epoch 00016: val_r2_keras improved from -0.52644 to -0.51123, saving model to /content/gdrive/My Drive/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 3s - loss: 15.7455 - rmse: 15.7455 - r2_keras: -5.7365e+00 - val_loss: 9.1565 - val_rmse: 9.1565 - val_r2_keras: -5.1123e-01
Epoch 17/300

Epoch 00017: val_r2_keras did not improve from -0.51123
3367/3367 - 3s - loss: 15.1804 - rmse: 15.1804 - r2_keras: -5.3975e+00 - val_loss: 17.1437 - val_rmse: 17.1437 - val_r2_keras: -5.3601e+00
Epoch 18/300

Epoch 00018: val_r2_keras did not improve from -0.51123
3367/3367 - 2s - loss: 14.7577 - rmse: 14.7577 - r2_keras: -5.0106e+00 - val_loss: 25.3634 - val_rmse: 25.3634 - val_r2_keras: -2.0961e+01
Epoch 19/300

Epoch 00019: val_r2_keras did not improve from -0.51123
3367/3367 - 3s - loss: 14.9236 - rmse: 14.9236 - r2_keras: -4.3220e+00 - val_loss: 6.5218 - val_rmse: 6.5218 - val_r2_keras: -2.7139e+01
Epoch 20/300

Epoch 00020: val_r2_keras did not improve from -0.51123
3367/3367 - 2s - loss: 14.6734 - rmse: 14.6734 - r2_keras: -4.3382e+00 - val_loss: 11.4709 - val_rmse: 11.4709 - val_r2_keras: -2.5714e+00
Epoch 21/300

Epoch 00021: val_r2_keras did not improve from -0.51123
3367/3367 - 3s - loss: 14.9571 - rmse: 14.9571 - r2_keras: -4.1811e+00 - val_loss: 6.8997 - val_rmse: 6.8998 - val_r2_keras: -3.3205e+00
Epoch 22/300

Epoch 00022: val_r2_keras improved from -0.51123 to 0.01811, saving model to /content/gdrive/My Drive/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 3s - loss: 14.7400 - rmse: 14.7400 - r2_keras: -4.4912e+00 - val_loss: 7.2406 - val_rmse: 7.2406 - val_r2_keras: 0.0181
Epoch 23/300

Epoch 00023: val_r2_keras did not improve from 0.01811
3367/3367 - 2s - loss: 14.9837 - rmse: 14.9837 - r2_keras: -6.1430e+00 - val_loss: 14.2389 - val_rmse: 14.2389 - val_r2_keras: -6.7624e+00
Epoch 24/300
```

```
Epoch 24/300

Epoch 00024: val_r2_keras did not improve from 0.01811
3367/3367 - 3s - loss: 14.4262 - rmse: 14.4262 - r2_keras: -4.8743e+00 - val_loss: 9.4536 - val_rm
se: 9.4536 - val_r2_keras: -1.0557e+00
Epoch 25/300

Epoch 00025: val_r2_keras did not improve from 0.01811
3367/3367 - 3s - loss: 14.2699 - rmse: 14.2699 - r2_keras: -4.1829e+00 - val_loss: 16.4879 - val_r
mse: 16.4879 - val_r2_keras: -5.5852e+00
Epoch 26/300

Epoch 00026: val_r2_keras did not improve from 0.01811
3367/3367 - 3s - loss: 14.3596 - rmse: 14.3596 - r2_keras: -5.5396e+00 - val_loss: 19.3465 - val_r
mse: 19.3465 - val_r2_keras: -5.2121e+00
Epoch 27/300

Epoch 00027: val_r2_keras did not improve from 0.01811
3367/3367 - 3s - loss: 14.4601 - rmse: 14.4601 - r2_keras: -4.8936e+00 - val_loss: 21.7808 - val_r
mse: 21.7808 - val_r2_keras: -1.0096e+01
Epoch 28/300

Epoch 00028: val_r2_keras improved from 0.01811 to 0.20713, saving model to /content/gdrive/My Dri
ve/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 3s - loss: 14.3256 - rmse: 14.3256 - r2_keras: -3.9460e+00 - val_loss: 6.3617 - val_rm
se: 6.3617 - val_r2_keras: 0.2071
Epoch 29/300

Epoch 00029: val_r2_keras did not improve from 0.20713
3367/3367 - 3s - loss: 13.7676 - rmse: 13.7676 - r2_keras: -3.7390e+00 - val_loss: 26.3788 - val_r
mse: 26.3788 - val_r2_keras: -1.0473e+01
Epoch 30/300

Epoch 00030: val_r2_keras did not improve from 0.20713
3367/3367 - 3s - loss: 14.6211 - rmse: 14.6211 - r2_keras: -4.0530e+00 - val_loss: 6.4519 - val_rm
se: 6.4519 - val_r2_keras: 0.0903
Epoch 31/300

Epoch 00031: val_r2_keras did not improve from 0.20713
3367/3367 - 2s - loss: 14.0709 - rmse: 14.0708 - r2_keras: -3.9669e+00 - val_loss: 8.2943 - val_rm
se: 8.2942 - val_r2_keras: -7.1292e-01
Epoch 32/300

Epoch 00032: val_r2_keras did not improve from 0.20713
3367/3367 - 3s - loss: 13.5019 - rmse: 13.5019 - r2_keras: -5.3000e+00 - val_loss: 6.0128 - val_rm
se: 6.0128 - val_r2_keras: 0.0244
Epoch 33/300

Epoch 00033: val_r2_keras did not improve from 0.20713
3367/3367 - 2s - loss: 13.5532 - rmse: 13.5532 - r2_keras: -3.3328e+00 - val_loss: 11.7647 - val_r
mse: 11.7647 - val_r2_keras: -2.9834e+00
Epoch 34/300

Epoch 00034: val_r2_keras did not improve from 0.20713
3367/3367 - 2s - loss: 13.9499 - rmse: 13.9499 - r2_keras: -3.3629e+00 - val_loss: 6.9349 - val_rm
se: 6.9349 - val_r2_keras: -3.9906e-01
Epoch 35/300

Epoch 00035: val_r2_keras did not improve from 0.20713
3367/3367 - 3s - loss: 13.7557 - rmse: 13.7556 - r2_keras: -3.2298e+00 - val_loss: 6.0587 - val_rm
se: 6.0587 - val_r2_keras: 0.1407
Epoch 36/300

Epoch 00036: val_r2_keras did not improve from 0.20713
3367/3367 - 3s - loss: 13.5283 - rmse: 13.5283 - r2_keras: -3.4706e+00 - val_loss: 15.1236 - val_r
mse: 15.1236 - val_r2_keras: -3.7926e+00
Epoch 37/300

Epoch 00037: val_r2_keras did not improve from 0.20713
3367/3367 - 3s - loss: 13.8577 - rmse: 13.8577 - r2_keras: -3.4176e+00 - val_loss: 12.9120 - val_r
mse: 12.9120 - val_r2_keras: -3.0975e+00
Epoch 38/300

Epoch 00038: val_r2_keras did not improve from 0.20713
3367/3367 - 2s - loss: 13.7290 - rmse: 13.7290 - r2_keras: -4.2954e+00 - val_loss: 15.6489 - val_r
mse: 15.6489 - val_r2_keras: -1.3705e+01
Epoch 39/300
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Epoch 00039: val_r2_keras did not improve from 0.20713
3367/3367 - 2s - loss: 14.2760 - rmse: 14.2760 - r2_keras: -3.9624e+00 - val_loss: 6.3333 - val_rm
se: 6.3333 - val_r2_keras: -1.4831e-01
Epoch 40/300

Epoch 00040: val_r2_keras did not improve from 0.20713
3367/3367 - 2s - loss: 13.9338 - rmse: 13.9338 - r2_keras: -4.0868e+00 - val_loss: 11.9438 - val_r
mse: 11.9438 - val_r2_keras: -4.0599e+00
Epoch 41/300

Epoch 00041: val_r2_keras did not improve from 0.20713
3367/3367 - 3s - loss: 13.6740 - rmse: 13.6741 - r2_keras: -3.4728e+00 - val_loss: 8.9210 - val_rm
se: 8.9210 - val_r2_keras: -2.0049e+00
Epoch 42/300

Epoch 00042: val_r2_keras did not improve from 0.20713
3367/3367 - 2s - loss: 13.8656 - rmse: 13.8656 - r2_keras: -4.6542e+00 - val_loss: 9.6391 - val_rm
se: 9.6391 - val_r2_keras: -2.8987e+00
Epoch 43/300

Epoch 00043: val_r2_keras did not improve from 0.20713
3367/3367 - 2s - loss: 13.2441 - rmse: 13.2441 - r2_keras: -3.3593e+00 - val_loss: 6.2451 - val_rm
se: 6.2451 - val_r2_keras: -1.7957e+01
Epoch 44/300

Epoch 00044: val_r2_keras did not improve from 0.20713
3367/3367 - 3s - loss: 13.2766 - rmse: 13.2766 - r2_keras: -2.9515e+00 - val_loss: 9.6410 - val_rm
se: 9.6410 - val_r2_keras: -1.8773e+00
Epoch 45/300

Epoch 00045: val_r2_keras did not improve from 0.20713
3367/3367 - 2s - loss: 13.3648 - rmse: 13.3648 - r2_keras: -4.1609e+00 - val_loss: 7.3862 - val_rm
se: 7.3862 - val_r2_keras: -6.5489e-01
Epoch 46/300

Epoch 00046: val_r2_keras did not improve from 0.20713
3367/3367 - 3s - loss: 13.3507 - rmse: 13.3507 - r2_keras: -2.9610e+00 - val_loss: 6.0382 - val_rm
se: 6.0382 - val_r2_keras: 0.0158
Epoch 47/300

Epoch 00047: val_r2_keras did not improve from 0.20713
3367/3367 - 2s - loss: 13.3689 - rmse: 13.3689 - r2_keras: -3.3735e+00 - val_loss: 6.7887 - val_rm
se: 6.7887 - val_r2_keras: -1.0709e+00
Epoch 48/300

Epoch 00048: val_r2_keras improved from 0.20713 to 0.20759, saving model to /content/gdrive/My Dri
ve/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 3s - loss: 13.3532 - rmse: 13.3532 - r2_keras: -3.8842e+00 - val_loss: 5.8181 - val_rm
se: 5.8181 - val_r2_keras: 0.2076
Epoch 49/300

Epoch 00049: val_r2_keras did not improve from 0.20759
3367/3367 - 2s - loss: 13.1776 - rmse: 13.1776 - r2_keras: -3.3815e+00 - val_loss: 5.2856 - val_rm
se: 5.2856 - val_r2_keras: 0.1792
Epoch 50/300

Epoch 00050: val_r2_keras did not improve from 0.20759
3367/3367 - 3s - loss: 13.2598 - rmse: 13.2598 - r2_keras: -3.2428e+00 - val_loss: 6.1258 - val_rm
se: 6.1258 - val_r2_keras: 0.0925
Epoch 51/300

Epoch 00051: val_r2_keras improved from 0.20759 to 0.21920, saving model to /content/gdrive/My Dri
ve/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 3s - loss: 13.4986 - rmse: 13.4986 - r2_keras: -3.3575e+00 - val_loss: 5.7277 - val_rm
se: 5.7277 - val_r2_keras: 0.2192
Epoch 52/300

Epoch 00052: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 12.9643 - rmse: 12.9643 - r2_keras: -3.5442e+00 - val_loss: 20.6674 - val_r
mse: 20.6674 - val_r2_keras: -8.3649e+00
Epoch 53/300

Epoch 00053: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 13.1391 - rmse: 13.1391 - r2_keras: -3.5023e+00 - val_loss: 7.5710 - val_rm
se: 7.5710 - val_r2_keras: -1.5916e-01
Epoch 54/300
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Epoch 00054: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 13.4357 - rmse: 13.4357 - r2_keras: -4.5228e+00 - val_loss: 7.7438 - val_rm
se: 7.7438 - val_r2_keras: -2.0047e-01
Epoch 55/300

Epoch 00055: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 12.6254 - rmse: 12.6254 - r2_keras: -2.8411e+00 - val_loss: 9.0578 - val_rm
se: 9.0578 - val_r2_keras: -1.1156e+00
Epoch 56/300

Epoch 00056: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 13.3591 - rmse: 13.3591 - r2_keras: -5.4672e+00 - val_loss: 30.6222 - val_r
mse: 30.6222 - val_r2_keras: -2.5043e+01
Epoch 57/300

Epoch 00057: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 13.5956 - rmse: 13.5956 - r2_keras: -4.7734e+00 - val_loss: 8.3052 - val_rm
se: 8.3052 - val_r2_keras: -1.0116e+00
Epoch 58/300

Epoch 00058: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 12.7154 - rmse: 12.7154 - r2_keras: -3.0178e+00 - val_loss: 8.3174 - val_rm
se: 8.3174 - val_r2_keras: -5.1797e+00
Epoch 59/300

Epoch 00059: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 13.0932 - rmse: 13.0932 - r2_keras: -3.9790e+00 - val_loss: 24.3569 - val_r
mse: 24.3569 - val_r2_keras: -2.2846e+02
Epoch 60/300

Epoch 00060: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 12.6287 - rmse: 12.6287 - r2_keras: -3.9710e+00 - val_loss: 10.0785 - val_r
mse: 10.0785 - val_r2_keras: -1.2707e+00
Epoch 61/300

Epoch 00061: val_r2_keras did not improve from 0.21920
3367/3367 - 2s - loss: 13.2404 - rmse: 13.2404 - r2_keras: -3.5305e+00 - val_loss: 6.7866 - val_rm
se: 6.7866 - val_r2_keras: -1.0888e-02
Epoch 62/300

Epoch 00062: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 12.8316 - rmse: 12.8316 - r2_keras: -3.2012e+00 - val_loss: 7.8427 - val_rm
se: 7.8427 - val_r2_keras: -7.0697e-01
Epoch 63/300

Epoch 00063: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 13.4370 - rmse: 13.4370 - r2_keras: -4.5149e+00 - val_loss: 17.8049 - val_r
mse: 17.8049 - val_r2_keras: -5.2531e+00
Epoch 64/300

Epoch 00064: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 12.7621 - rmse: 12.7621 - r2_keras: -3.6544e+00 - val_loss: 14.7701 - val_r
mse: 14.7701 - val_r2_keras: -2.9112e+00
Epoch 65/300

Epoch 00065: val_r2_keras did not improve from 0.21920
3367/3367 - 2s - loss: 12.8659 - rmse: 12.8659 - r2_keras: -2.9584e+00 - val_loss: 6.2133 - val_rm
se: 6.2133 - val_r2_keras: 0.1141
Epoch 66/300

Epoch 00066: val_r2_keras did not improve from 0.21920
3367/3367 - 3s - loss: 13.3055 - rmse: 13.3055 - r2_keras: -3.4377e+00 - val_loss: 5.7933 - val_rm
se: 5.7933 - val_r2_keras: -4.5350e-01
Epoch 67/300

Epoch 00067: val_r2_keras improved from 0.21920 to 0.24378, saving model to /content/gdrive/My Dri
ve/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 3s - loss: 13.0531 - rmse: 13.0531 - r2_keras: -3.6067e+00 - val_loss: 6.1847 - val_rm
se: 6.1847 - val_r2_keras: 0.2438
Epoch 68/300

Epoch 00068: val_r2_keras did not improve from 0.24378
3367/3367 - 2s - loss: 12.7888 - rmse: 12.7888 - r2_keras: -3.1661e+00 - val_loss: 8.1876 - val_rm
se: 8.1876 - val_r2_keras: -5.1814e-01
Epoch 69/300
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Epoch 00069: val_r2_keras did not improve from 0.24378
3367/3367 - 3s - loss: 12.6677 - rmse: 12.6677 - r2_keras: -2.7436e+00 - val_loss: 10.9920 - val_r
mse: 10.9920 - val_r2_keras: -2.8291e+00
Epoch 70/300

Epoch 00070: val_r2_keras did not improve from 0.24378
3367/3367 - 3s - loss: 12.7588 - rmse: 12.7588 - r2_keras: -2.7567e+00 - val_loss: 8.3879 - val_rm
se: 8.3879 - val_r2_keras: -1.3583e+00
Epoch 71/300

Epoch 00071: val_r2_keras did not improve from 0.24378
3367/3367 - 3s - loss: 12.7746 - rmse: 12.7746 - r2_keras: -3.1874e+00 - val_loss: 5.9475 - val_rm
se: 5.9475 - val_r2_keras: 0.1806
Epoch 72/300

Epoch 00072: val_r2_keras did not improve from 0.24378
3367/3367 - 2s - loss: 12.9762 - rmse: 12.9762 - r2_keras: -3.1663e+00 - val_loss: 5.4497 - val_rm
se: 5.4497 - val_r2_keras: -8.0652e-02
Epoch 73/300

Epoch 00073: val_r2_keras did not improve from 0.24378
3367/3367 - 3s - loss: 12.6505 - rmse: 12.6505 - r2_keras: -3.9405e+00 - val_loss: 10.9436 - val_r
mse: 10.9436 - val_r2_keras: -1.6748e+00
Epoch 74/300

Epoch 00074: val_r2_keras did not improve from 0.24378
3367/3367 - 2s - loss: 13.0815 - rmse: 13.0815 - r2_keras: -3.3215e+00 - val_loss: 19.2068 - val_r
mse: 19.2068 - val_r2_keras: -7.4731e+00
Epoch 75/300

Epoch 00075: val_r2_keras did not improve from 0.24378
3367/3367 - 2s - loss: 12.9762 - rmse: 12.9762 - r2_keras: -2.5880e+00 - val_loss: 5.6765 - val_rm
se: 5.6765 - val_r2_keras: 0.1632
Epoch 76/300

Epoch 00076: val_r2_keras did not improve from 0.24378
3367/3367 - 2s - loss: 12.9308 - rmse: 12.9308 - r2_keras: -2.9941e+00 - val_loss: 7.1453 - val_rm
se: 7.1453 - val_r2_keras: -8.1050e-01
Epoch 77/300

Epoch 00077: val_r2_keras did not improve from 0.24378
3367/3367 - 3s - loss: 13.0290 - rmse: 13.0290 - r2_keras: -2.9976e+00 - val_loss: 8.9749 - val_rm
se: 8.9749 - val_r2_keras: -1.0130e+00
Epoch 78/300

Epoch 00078: val_r2_keras did not improve from 0.24378
3367/3367 - 2s - loss: 13.1989 - rmse: 13.1989 - r2_keras: -3.2935e+00 - val_loss: 10.9679 - val_r
mse: 10.9679 - val_r2_keras: -1.6314e+00
Epoch 79/300

Epoch 00079: val_r2_keras did not improve from 0.24378
3367/3367 - 3s - loss: 12.6236 - rmse: 12.6236 - r2_keras: -3.4886e+00 - val_loss: 8.1917 - val_rm
se: 8.1917 - val_r2_keras: -4.6943e-01
Epoch 80/300

Epoch 00080: val_r2_keras did not improve from 0.24378
3367/3367 - 3s - loss: 12.6009 - rmse: 12.6009 - r2_keras: -2.6963e+00 - val_loss: 6.5585 - val_rm
se: 6.5585 - val_r2_keras: -1.3887e+01
Epoch 81/300

Epoch 00081: val_r2_keras improved from 0.24378 to 0.28496, saving model to /content/gdrive/My Dri
ve/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 3s - loss: 12.5202 - rmse: 12.5202 - r2_keras: -3.4463e+00 - val_loss: 5.5424 - val_rm
se: 5.5424 - val_r2_keras: 0.2850
Epoch 82/300

Epoch 00082: val_r2_keras did not improve from 0.28496
3367/3367 - 2s - loss: 13.0529 - rmse: 13.0529 - r2_keras: -2.9809e+00 - val_loss: 18.5681 - val_r
mse: 18.5681 - val_r2_keras: -1.2560e+01
Epoch 83/300

Epoch 00083: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.5064 - rmse: 12.5064 - r2_keras: -5.3227e+03 - val_loss: 7.0955 - val_rm
se: 7.0955 - val_r2_keras: -2.4190e-01
Epoch 84/300

Epoch 00084: val_r2_keras did not improve from 0.28496
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3367/3367 - 3s - loss: 12.8090 - rmse: 12.8090 - r2_keras: -3.0132e+00 - val_loss: 16.2697 - val_r
mse: 16.2697 - val_r2_keras: -4.1450e+00
Epoch 85/300

Epoch 00085: val_r2_keras did not improve from 0.28496
3367/3367 - 2s - loss: 12.6112 - rmse: 12.6112 - r2_keras: -2.9624e+00 - val_loss: 5.7098 - val_rm
se: 5.7098 - val_r2_keras: 0.0395
Epoch 86/300

Epoch 00086: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.2578 - rmse: 12.2578 - r2_keras: -2.9776e+00 - val_loss: 8.6950 - val_rm
se: 8.6950 - val_r2_keras: -2.3283e+00
Epoch 87/300

Epoch 00087: val_r2_keras did not improve from 0.28496
3367/3367 - 2s - loss: 12.8489 - rmse: 12.8489 - r2_keras: -4.8562e+00 - val_loss: 8.4001 - val_rm
se: 8.4001 - val_r2_keras: -1.3458e+00
Epoch 88/300

Epoch 00088: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.5028 - rmse: 12.5028 - r2_keras: -6.6778e+00 - val_loss: 12.5969 - val_r
mse: 12.5969 - val_r2_keras: -1.8920e+00
Epoch 89/300

Epoch 00089: val_r2_keras did not improve from 0.28496
3367/3367 - 2s - loss: 12.3426 - rmse: 12.3426 - r2_keras: -2.8923e+00 - val_loss: 8.2932 - val_rm
se: 8.2932 - val_r2_keras: -6.8704e-01
Epoch 90/300

Epoch 00090: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.5063 - rmse: 12.5063 - r2_keras: -2.9352e+00 - val_loss: 8.3673 - val_rm
se: 8.3673 - val_r2_keras: -5.9557e-01
Epoch 91/300

Epoch 00091: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.4294 - rmse: 12.4294 - r2_keras: -2.3511e+00 - val_loss: 10.7990 - val_r
mse: 10.7990 - val_r2_keras: -1.2929e+00
Epoch 92/300

Epoch 00092: val_r2_keras did not improve from 0.28496
3367/3367 - 2s - loss: 12.3913 - rmse: 12.3913 - r2_keras: -2.6978e+00 - val_loss: 8.5971 - val_rm
se: 8.5971 - val_r2_keras: -1.2560e+00
Epoch 93/300

Epoch 00093: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.2777 - rmse: 12.2777 - r2_keras: -2.5431e+00 - val_loss: 8.8967 - val_rm
se: 8.8967 - val_r2_keras: -9.2918e-01
Epoch 94/300

Epoch 00094: val_r2_keras did not improve from 0.28496
3367/3367 - 2s - loss: 12.1724 - rmse: 12.1724 - r2_keras: -2.9852e+00 - val_loss: 15.8608 - val_r
mse: 15.8608 - val_r2_keras: -3.2631e+00
Epoch 95/300

Epoch 00095: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.2034 - rmse: 12.2034 - r2_keras: -2.6414e+00 - val_loss: 14.5454 - val_r
mse: 14.5454 - val_r2_keras: -3.5803e+00
Epoch 96/300

Epoch 00096: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 13.1371 - rmse: 13.1371 - r2_keras: -3.2439e+00 - val_loss: 9.3549 - val_rm
se: 9.3549 - val_r2_keras: -8.9658e-01
Epoch 97/300

Epoch 00097: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.5818 - rmse: 12.5819 - r2_keras: -2.7402e+00 - val_loss: 6.5537 - val_rm
se: 6.5537 - val_r2_keras: 0.0555
Epoch 98/300

Epoch 00098: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.8166 - rmse: 12.8166 - r2_keras: -3.0866e+00 - val_loss: 6.1906 - val_rm
se: 6.1906 - val_r2_keras: -9.0608e-02
Epoch 99/300

Epoch 00099: val_r2_keras did not improve from 0.28496
3367/3367 - 2s - loss: 12.4196 - rmse: 12.4196 - r2_keras: -2.8097e+00 - val_loss: 6.6699 - val_rm
se: 6.6699 - val_r2_keras: 0.1049
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Epoch 100/300

Epoch 00100: val_r2_keras did not improve from 0.28496
3367/3367 - 2s - loss: 12.3688 - rmse: 12.3688 - r2_keras: -2.4941e+00 - val_loss: 10.6115 - val_r
mse: 10.6115 - val_r2_keras: -8.6342e+00
Epoch 101/300

Epoch 00101: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.6290 - rmse: 12.6289 - r2_keras: -2.7501e+00 - val_loss: 5.2558 - val_rm
se: 5.2558 - val_r2_keras: 0.2211
Epoch 102/300

Epoch 00102: val_r2_keras did not improve from 0.28496
3367/3367 - 2s - loss: 11.9021 - rmse: 11.9020 - r2_keras: -2.3959e+00 - val_loss: 7.9033 - val_rm
se: 7.9033 - val_r2_keras: -4.0787e-01
Epoch 103/300

Epoch 00103: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.2012 - rmse: 12.2012 - r2_keras: -2.2049e+00 - val_loss: 6.0651 - val_rm
se: 6.0651 - val_r2_keras: 0.0471
Epoch 104/300

Epoch 00104: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.6295 - rmse: 12.6295 - r2_keras: -2.8718e+00 - val_loss: 7.6523 - val_rm
se: 7.6523 - val_r2_keras: -4.4447e-01
Epoch 105/300

Epoch 00105: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.9489 - rmse: 12.9489 - r2_keras: -3.9366e+00 - val_loss: 13.3783 - val_r
mse: 13.3783 - val_r2_keras: -3.8983e+00
Epoch 106/300

Epoch 00106: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.4209 - rmse: 12.4209 - r2_keras: -2.7434e+00 - val_loss: 8.8432 - val_rm
se: 8.8432 - val_r2_keras: -1.0496e+00
Epoch 107/300

Epoch 00107: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.1449 - rmse: 12.1449 - r2_keras: -2.7115e+00 - val_loss: 14.2555 - val_r
mse: 14.2555 - val_r2_keras: -3.2236e+00
Epoch 108/300

Epoch 00108: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.2113 - rmse: 12.2113 - r2_keras: -2.8217e+00 - val_loss: 11.9516 - val_r
mse: 11.9516 - val_r2_keras: -2.9368e+00
Epoch 109/300

Epoch 00109: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.2094 - rmse: 12.2094 - r2_keras: -2.3995e+00 - val_loss: 6.2981 - val_rm
se: 6.2981 - val_r2_keras: -1.1135e+00
Epoch 110/300

Epoch 00110: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 13.0725 - rmse: 13.0725 - r2_keras: -2.6485e+00 - val_loss: 7.4757 - val_rm
se: 7.4757 - val_r2_keras: -3.5731e-01
Epoch 111/300

Epoch 00111: val_r2_keras did not improve from 0.28496
3367/3367 - 2s - loss: 12.2284 - rmse: 12.2284 - r2_keras: -3.7614e+00 - val_loss: 8.1882 - val_rm
se: 8.1882 - val_r2_keras: -8.9852e-01
Epoch 112/300

Epoch 00112: val_r2_keras did not improve from 0.28496
3367/3367 - 3s - loss: 12.1743 - rmse: 12.1743 - r2_keras: -3.8700e+00 - val_loss: 8.8089 - val_rm
se: 8.8089 - val_r2_keras: -1.1861e+00
Epoch 113/300

Epoch 00113: val_r2_keras did not improve from 0.28496
3367/3367 - 2s - loss: 11.8649 - rmse: 11.8648 - r2_keras: -2.2629e+00 - val_loss: 14.9351 - val_r
mse: 14.9351 - val_r2_keras: -6.3661e+00
Epoch 114/300

Epoch 00114: val_r2_keras did not improve from 0.28496
3367/3367 - 2s - loss: 13.0048 - rmse: 13.0048 - r2_keras: -2.6628e+00 - val_loss: 5.5046 - val_rm
se: 5.5046 - val_r2_keras: 0.2031
Epoch 115/300
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Epoch 00115: val_r2_keras improved from 0.28496 to 0.36402, saving model to /content/gdrive/My Dri
ve/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 3s - loss: 12.0216 - rmse: 12.0216 - r2_keras: -3.0022e+00 - val_loss: 5.3328 - val_rm
se: 5.3328 - val_r2_keras: 0.3640
Epoch 116/300

Epoch 00116: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 12.4690 - rmse: 12.4690 - r2_keras: -3.0626e+00 - val_loss: 4.9499 - val_rm
se: 4.9499 - val_r2_keras: 0.2956
Epoch 117/300

Epoch 00117: val_r2_keras did not improve from 0.36402
3367/3367 - 2s - loss: 12.0439 - rmse: 12.0439 - r2_keras: -3.3134e+00 - val_loss: 5.4448 - val_rm
se: 5.4448 - val_r2_keras: 0.1840
Epoch 118/300

Epoch 00118: val_r2_keras did not improve from 0.36402
3367/3367 - 2s - loss: 11.9838 - rmse: 11.9838 - r2_keras: -2.4360e+00 - val_loss: 8.1987 - val_rm
se: 8.1987 - val_r2_keras: -6.4942e-01
Epoch 119/300

Epoch 00119: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 11.8780 - rmse: 11.8780 - r2_keras: -2.0135e+00 - val_loss: 9.0648 - val_rm
se: 9.0648 - val_r2_keras: -8.4209e-01
Epoch 120/300

Epoch 00120: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 11.8756 - rmse: 11.8756 - r2_keras: -2.7485e+00 - val_loss: 5.5040 - val_rm
se: 5.5040 - val_r2_keras: 0.0671
Epoch 121/300

Epoch 00121: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 12.1148 - rmse: 12.1148 - r2_keras: -2.6479e+00 - val_loss: 7.7390 - val_rm
se: 7.7390 - val_r2_keras: -3.8518e-01
Epoch 122/300

Epoch 00122: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 12.3073 - rmse: 12.3073 - r2_keras: -4.0905e+00 - val_loss: 9.3142 - val_rm
se: 9.3142 - val_r2_keras: -1.0535e+00
Epoch 123/300

Epoch 00123: val_r2_keras did not improve from 0.36402
3367/3367 - 2s - loss: 12.0476 - rmse: 12.0476 - r2_keras: -2.1485e+00 - val_loss: 5.3346 - val_rm
se: 5.3346 - val_r2_keras: 0.1332
Epoch 124/300

Epoch 00124: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 12.5244 - rmse: 12.5244 - r2_keras: -3.0188e+00 - val_loss: 6.5740 - val_rm
se: 6.5740 - val_r2_keras: -8.0544e-02
Epoch 125/300

Epoch 00125: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 12.0003 - rmse: 12.0003 - r2_keras: -2.3920e+00 - val_loss: 24.7872 - val_r
mse: 24.7872 - val_r2_keras: -1.1770e+01
Epoch 126/300

Epoch 00126: val_r2_keras did not improve from 0.36402
3367/3367 - 2s - loss: 12.4592 - rmse: 12.4592 - r2_keras: -4.1407e+00 - val_loss: 10.9823 - val_r
mse: 10.9823 - val_r2_keras: -2.3009e+00
Epoch 127/300

Epoch 00127: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 12.0510 - rmse: 12.0510 - r2_keras: -3.4410e+00 - val_loss: 7.1545 - val_rm
se: 7.1545 - val_r2_keras: -3.2147e-01
Epoch 128/300

Epoch 00128: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 11.7883 - rmse: 11.7883 - r2_keras: -2.3059e+00 - val_loss: 7.0089 - val_rm
se: 7.0089 - val_r2_keras: -6.1302e-01
Epoch 129/300

Epoch 00129: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 11.8694 - rmse: 11.8694 - r2_keras: -2.7668e+00 - val_loss: 5.6704 - val_rm
se: 5.6704 - val_r2_keras: 0.0125
Epoch 130/300

Epoch 00130: val_r2_keras did not improve from 0.36402
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3367/3367 - 2s - loss: 11.8008 - rmse: 11.8007 - r2_keras: -2.2800e+00 - val_loss: 5.5080 - val_rm
se: 5.5080 - val_r2_keras: -6.8136e-01
Epoch 131/300

Epoch 00131: val_r2_keras did not improve from 0.36402
3367/3367 - 2s - loss: 12.0511 - rmse: 12.0511 - r2_keras: -2.2252e+00 - val_loss: 15.9123 - val_r
mse: 15.9123 - val_r2_keras: -5.0262e+00
Epoch 132/300

Epoch 00132: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 11.9736 - rmse: 11.9735 - r2_keras: -2.4516e+00 - val_loss: 5.0576 - val_rm
se: 5.0576 - val_r2_keras: 0.3176
Epoch 133/300

Epoch 00133: val_r2_keras did not improve from 0.36402
3367/3367 - 2s - loss: 11.5532 - rmse: 11.5532 - r2_keras: -2.4388e+00 - val_loss: 6.4159 - val_rm
se: 6.4159 - val_r2_keras: -9.5527e-01
Epoch 134/300

Epoch 00134: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 11.5187 - rmse: 11.5187 - r2_keras: -2.7092e+00 - val_loss: 9.3764 - val_rm
se: 9.3764 - val_r2_keras: -8.8190e-01
Epoch 135/300

Epoch 00135: val_r2_keras did not improve from 0.36402
3367/3367 - 3s - loss: 11.9336 - rmse: 11.9336 - r2_keras: -2.3457e+00 - val_loss: 17.7696 - val_r
mse: 17.7696 - val_r2_keras: -7.3148e+00
Epoch 136/300

Epoch 00136: val_r2_keras did not improve from 0.36402
3367/3367 - 2s - loss: 12.2962 - rmse: 12.2962 - r2_keras: -2.3429e+00 - val_loss: 17.5368 - val_r
mse: 17.5368 - val_r2_keras: -4.8500e+00
Epoch 137/300

Epoch 00137: val_r2_keras improved from 0.36402 to 0.37634, saving model to /content/gdrive/My Dri
ve/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 3s - loss: 11.9322 - rmse: 11.9322 - r2_keras: -2.4536e+00 - val_loss: 4.8401 - val_rm
se: 4.8401 - val_r2_keras: 0.3763
Epoch 138/300

Epoch 00138: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 12.0063 - rmse: 12.0063 - r2_keras: -2.3779e+00 - val_loss: 5.7756 - val_rm
se: 5.7756 - val_r2_keras: -6.5369e-02
Epoch 139/300

Epoch 00139: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 12.0127 - rmse: 12.0127 - r2_keras: -2.9437e+00 - val_loss: 5.6953 - val_rm
se: 5.6953 - val_r2_keras: 0.0239
Epoch 140/300

Epoch 00140: val_r2_keras did not improve from 0.37634
3367/3367 - 2s - loss: 11.9646 - rmse: 11.9646 - r2_keras: -2.4119e+00 - val_loss: 7.3852 - val_rm
se: 7.3852 - val_r2_keras: -4.0394e-01
Epoch 141/300

Epoch 00141: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 12.0345 - rmse: 12.0345 - r2_keras: -2.5659e+00 - val_loss: 7.9771 - val_rm
se: 7.9771 - val_r2_keras: -8.4269e-01
Epoch 142/300

Epoch 00142: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 11.5059 - rmse: 11.5059 - r2_keras: -2.1149e+00 - val_loss: 24.6120 - val_r
mse: 24.6120 - val_r2_keras: -1.0495e+01
Epoch 143/300

Epoch 00143: val_r2_keras did not improve from 0.37634
3367/3367 - 2s - loss: 11.6495 - rmse: 11.6495 - r2_keras: -2.4450e+00 - val_loss: 5.3641 - val_rm
se: 5.3641 - val_r2_keras: 0.3131
Epoch 144/300

Epoch 00144: val_r2_keras did not improve from 0.37634
3367/3367 - 2s - loss: 11.7235 - rmse: 11.7235 - r2_keras: -2.2469e+00 - val_loss: 6.7194 - val_rm
se: 6.7194 - val_r2_keras: -5.3561e-01
Epoch 145/300

Epoch 00145: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 11.6734 - rmse: 11.6734 - r2_keras: -2.3958e+00 - val_loss: 7.8734 - val_rm
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se: 7.8734 - val_r2_keras: -3.9042e-01
Epoch 146/300

Epoch 00146: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 11.3995 - rmse: 11.3995 - r2_keras: -1.9782e+00 - val_loss: 8.4391 - val_rm
se: 8.4391 - val_r2_keras: -5.4816e-01
Epoch 147/300

Epoch 00147: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 11.9509 - rmse: 11.9509 - r2_keras: -2.3757e+00 - val_loss: 5.5986 - val_rm
se: 5.5986 - val_r2_keras: 0.0744
Epoch 148/300

Epoch 00148: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 11.9449 - rmse: 11.9449 - r2_keras: -2.2348e+00 - val_loss: 12.4030 - val_r
mse: 12.4030 - val_r2_keras: -2.1970e+00
Epoch 149/300

Epoch 00149: val_r2_keras did not improve from 0.37634
3367/3367 - 2s - loss: 11.8393 - rmse: 11.8393 - r2_keras: -2.8555e+00 - val_loss: 5.3272 - val_rm
se: 5.3272 - val_r2_keras: 0.3739
Epoch 150/300

Epoch 00150: val_r2_keras did not improve from 0.37634
3367/3367 - 2s - loss: 11.5295 - rmse: 11.5295 - r2_keras: -2.2163e+00 - val_loss: 16.3172 - val_r
mse: 16.3172 - val_r2_keras: -4.3731e+00
Epoch 151/300

Epoch 00151: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 11.4417 - rmse: 11.4417 - r2_keras: -2.2374e+00 - val_loss: 7.2868 - val_rm
se: 7.2868 - val_r2_keras: -4.1198e-01
Epoch 152/300

Epoch 00152: val_r2_keras did not improve from 0.37634
3367/3367 - 2s - loss: 11.9127 - rmse: 11.9127 - r2_keras: -2.2928e+00 - val_loss: 14.9500 - val_r
mse: 14.9500 - val_r2_keras: -5.0463e+02
Epoch 153/300

Epoch 00153: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 12.1129 - rmse: 12.1129 - r2_keras: -2.5901e+00 - val_loss: 14.0536 - val_r
mse: 14.0536 - val_r2_keras: -3.6736e+00
Epoch 154/300

Epoch 00154: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 11.5685 - rmse: 11.5685 - r2_keras: -2.5687e+00 - val_loss: 8.1330 - val_rm
se: 8.1330 - val_r2_keras: -1.1428e+00
Epoch 155/300

Epoch 00155: val_r2_keras did not improve from 0.37634
3367/3367 - 2s - loss: 11.7797 - rmse: 11.7797 - r2_keras: -2.0658e+02 - val_loss: 9.1681 - val_rm
se: 9.1681 - val_r2_keras: -1.0781e+00
Epoch 156/300

Epoch 00156: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 11.5260 - rmse: 11.5260 - r2_keras: -2.0465e+00 - val_loss: 10.2440 - val_r
mse: 10.2440 - val_r2_keras: -1.5010e+00
Epoch 157/300

Epoch 00157: val_r2_keras did not improve from 0.37634
3367/3367 - 2s - loss: 11.8012 - rmse: 11.8012 - r2_keras: -3.0929e+00 - val_loss: 20.7800 - val_r
mse: 20.7800 - val_r2_keras: -6.7084e+00
Epoch 158/300

Epoch 00158: val_r2_keras did not improve from 0.37634
3367/3367 - 2s - loss: 11.7696 - rmse: 11.7696 - r2_keras: -2.1180e+00 - val_loss: 12.3054 - val_r
mse: 12.3054 - val_r2_keras: -2.0738e+00
Epoch 159/300

Epoch 00159: val_r2_keras did not improve from 0.37634
3367/3367 - 3s - loss: 11.4898 - rmse: 11.4898 - r2_keras: -2.1887e+00 - val_loss: 23.0279 - val_r
mse: 23.0279 - val_r2_keras: -1.1271e+01
Epoch 160/300

Epoch 00160: val_r2_keras did not improve from 0.37634
3367/3367 - 2s - loss: 11.6100 - rmse: 11.6101 - r2_keras: -2.1749e+00 - val_loss: 8.5625 - val_rm
se: 8.5625 - val_r2_keras: -6.0287e-01
Epoch 161/300
```

```
Epoch 00161: val_r2_keras improved from 0.37634 to 0.40852, saving model to /content/gdrive/My Dri
ve/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 3s - loss: 11.6844 - rmse: 11.6844 - r2_keras: -2.1123e+00 - val_loss: 5.4364 - val_rm
se: 5.4364 - val_r2_keras: 0.4085
Epoch 162/300

Epoch 00162: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.5272 - rmse: 11.5272 - r2_keras: -2.8889e+00 - val_loss: 5.1580 - val_rm
se: 5.1580 - val_r2_keras: 0.2417
Epoch 163/300

Epoch 00163: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.2531 - rmse: 11.2531 - r2_keras: -2.2632e+00 - val_loss: 5.8913 - val_rm
se: 5.8913 - val_r2_keras: 0.0247
Epoch 164/300

Epoch 00164: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.3826 - rmse: 11.3826 - r2_keras: -1.8418e+00 - val_loss: 11.5466 - val_r
mse: 11.5466 - val_r2_keras: -1.9907e+00
Epoch 165/300

Epoch 00165: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.3648 - rmse: 11.3648 - r2_keras: -2.1232e+00 - val_loss: 5.4942 - val_rm
se: 5.4942 - val_r2_keras: 0.2785
Epoch 166/300

Epoch 00166: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.0503 - rmse: 11.0503 - r2_keras: -1.8241e+00 - val_loss: 8.3565 - val_rm
se: 8.3565 - val_r2_keras: -8.2680e-01
Epoch 167/300

Epoch 00167: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.5151 - rmse: 11.5151 - r2_keras: -2.7339e+00 - val_loss: 6.4503 - val_rm
se: 6.4503 - val_r2_keras: -7.8988e-02
Epoch 168/300

Epoch 00168: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.5433 - rmse: 11.5433 - r2_keras: -2.0709e+00 - val_loss: 5.9741 - val_rm
se: 5.9741 - val_r2_keras: -4.4791e+00
Epoch 169/300

Epoch 00169: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.8763 - rmse: 11.8763 - r2_keras: -2.4929e+00 - val_loss: 5.2130 - val_rm
se: 5.2130 - val_r2_keras: 0.0466
Epoch 170/300

Epoch 00170: val_r2_keras did not improve from 0.40852
3367/3367 - 2s - loss: 11.5678 - rmse: 11.5677 - r2_keras: -2.2265e+00 - val_loss: 7.6109 - val_rm
se: 7.6109 - val_r2_keras: -2.0116e+00
Epoch 171/300

Epoch 00171: val_r2_keras did not improve from 0.40852
3367/3367 - 2s - loss: 11.5481 - rmse: 11.5481 - r2_keras: -2.3704e+00 - val_loss: 17.6024 - val_r
mse: 17.6024 - val_r2_keras: -7.6772e+00
Epoch 172/300

Epoch 00172: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.2709 - rmse: 11.2710 - r2_keras: -4.8912e+00 - val_loss: 5.7028 - val_rm
se: 5.7028 - val_r2_keras: 0.2684
Epoch 173/300

Epoch 00173: val_r2_keras did not improve from 0.40852
3367/3367 - 2s - loss: 11.2194 - rmse: 11.2194 - r2_keras: -3.8560e+00 - val_loss: 8.1248 - val_rm
se: 8.1248 - val_r2_keras: -8.7666e-01
Epoch 174/300

Epoch 00174: val_r2_keras did not improve from 0.40852
3367/3367 - 2s - loss: 11.0434 - rmse: 11.0433 - r2_keras: -1.8273e+00 - val_loss: 9.0835 - val_rm
se: 9.0835 - val_r2_keras: -1.1575e+00
Epoch 175/300

Epoch 00175: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.5955 - rmse: 11.5955 - r2_keras: -2.3700e+00 - val_loss: 6.6121 - val_rm
se: 6.6121 - val_r2_keras: -1.8489e-01
Epoch 176/300
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Epoch 00176: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.3933 - rmse: 11.3933 - r2_keras: -3.4239e+00 - val_loss: 12.8771 - val_r
mse: 12.8771 - val_r2_keras: -3.3685e+00
Epoch 177/300

Epoch 00177: val_r2_keras did not improve from 0.40852
3367/3367 - 2s - loss: 11.2780 - rmse: 11.2780 - r2_keras: -1.8474e+00 - val_loss: 8.6604 - val_rm
se: 8.6604 - val_r2_keras: -9.6284e-01
Epoch 178/300

Epoch 00178: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.7317 - rmse: 11.7317 - r2_keras: -2.3782e+00 - val_loss: 9.3236 - val_rm
se: 9.3236 - val_r2_keras: -1.8393e+00
Epoch 179/300

Epoch 00179: val_r2_keras did not improve from 0.40852
3367/3367 - 2s - loss: 11.2544 - rmse: 11.2544 - r2_keras: -1.9630e+00 - val_loss: 5.3008 - val_rm
se: 5.3008 - val_r2_keras: 0.3611
Epoch 180/300

Epoch 00180: val_r2_keras did not improve from 0.40852
3367/3367 - 3s - loss: 11.0117 - rmse: 11.0117 - r2_keras: -1.1126e+01 - val_loss: 5.2524 - val_rm
se: 5.2524 - val_r2_keras: 0.2546
Epoch 181/300

Epoch 00181: val_r2_keras improved from 0.40852 to 0.49050, saving model to /content/gdrive/My Dri
ve/SelfCaseStudy/train/attempt_1/cp.ckpt
3367/3367 - 3s - loss: 11.4095 - rmse: 11.4095 - r2_keras: -5.2213e+00 - val_loss: 4.8997 - val_rm
se: 4.8997 - val_r2_keras: 0.4905
Epoch 182/300

Epoch 00182: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 11.4033 - rmse: 11.4033 - r2_keras: -2.2136e+00 - val_loss: 10.4536 - val_r
mse: 10.4536 - val_r2_keras: -1.5498e+00
Epoch 183/300

Epoch 00183: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.0348 - rmse: 11.0348 - r2_keras: -2.1540e+00 - val_loss: 7.4111 - val_rm
se: 7.4111 - val_r2_keras: -2.8870e-01
Epoch 184/300

Epoch 00184: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.9817 - rmse: 10.9817 - r2_keras: -1.8292e+00 - val_loss: 8.5955 - val_rm
se: 8.5955 - val_r2_keras: -8.2993e-01
Epoch 185/300

Epoch 00185: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.9994 - rmse: 10.9994 - r2_keras: -1.7883e+00 - val_loss: 16.4833 - val_r
mse: 16.4833 - val_r2_keras: -4.2599e+00
Epoch 186/300

Epoch 00186: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 11.4160 - rmse: 11.4160 - r2_keras: -2.0706e+00 - val_loss: 7.3868 - val_rm
se: 7.3868 - val_r2_keras: -3.3721e-01
Epoch 187/300

Epoch 00187: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 11.1156 - rmse: 11.1156 - r2_keras: -2.0039e+00 - val_loss: 5.2956 - val_rm
se: 5.2956 - val_r2_keras: 0.1453
Epoch 188/300

Epoch 00188: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 11.3485 - rmse: 11.3485 - r2_keras: -2.1720e+00 - val_loss: 14.1056 - val_r
mse: 14.1056 - val_r2_keras: -2.2517e+02
Epoch 189/300

Epoch 00189: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.2660 - rmse: 11.2660 - r2_keras: -1.8297e+00 - val_loss: 5.1541 - val_rm
se: 5.1540 - val_r2_keras: 0.3625
Epoch 190/300

Epoch 00190: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.0689 - rmse: 11.0689 - r2_keras: -1.7519e+00 - val_loss: 5.0357 - val_rm
se: 5.0357 - val_r2_keras: 0.3897
Epoch 191/300

Epoch 00191: val_r2_keras did not improve from 0.49050
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3367/3367 - 3s - loss: 11.4157 - rmse: 11.4157 - r2_keras: -1.8078e+00 - val_loss: 5.1428 - val_rm
se: 5.1428 - val_r2_keras: 0.3352
Epoch 192/300

Epoch 00192: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.9917 - rmse: 10.9917 - r2_keras: -1.7509e+00 - val_loss: 5.7146 - val_rm
se: 5.7146 - val_r2_keras: 0.1192
Epoch 193/300

Epoch 00193: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.0514 - rmse: 11.0514 - r2_keras: -2.0373e+00 - val_loss: 5.4975 - val_rm
se: 5.4975 - val_r2_keras: 0.3534
Epoch 194/300

Epoch 00194: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.0944 - rmse: 11.0944 - r2_keras: -1.8178e+00 - val_loss: 7.0878 - val_rm
se: 7.0878 - val_r2_keras: -2.0986e-01
Epoch 195/300

Epoch 00195: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.1971 - rmse: 11.1971 - r2_keras: -2.2733e+00 - val_loss: 5.5578 - val_rm
se: 5.5578 - val_r2_keras: 0.1715
Epoch 196/300

Epoch 00196: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.2498 - rmse: 11.2498 - r2_keras: -1.6501e+00 - val_loss: 14.1722 - val_r
mse: 14.1722 - val_r2_keras: -2.7224e+00
Epoch 197/300

Epoch 00197: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.5952 - rmse: 11.5952 - r2_keras: -2.5347e+00 - val_loss: 5.0456 - val_rm
se: 5.0456 - val_r2_keras: -2.2916e-01
Epoch 198/300

Epoch 00198: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.1402 - rmse: 11.1402 - r2_keras: -2.1111e+00 - val_loss: 5.9252 - val_rm
se: 5.9252 - val_r2_keras: 0.0179
Epoch 199/300

Epoch 00199: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.2996 - rmse: 11.2996 - r2_keras: -1.6755e+00 - val_loss: 4.9128 - val_rm
se: 4.9128 - val_r2_keras: 0.3540
Epoch 200/300

Epoch 00200: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.2977 - rmse: 11.2977 - r2_keras: -1.8626e+00 - val_loss: 9.6980 - val_rm
se: 9.6980 - val_r2_keras: -8.5395e-01
Epoch 201/300

Epoch 00201: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.6098 - rmse: 11.6098 - r2_keras: -3.3015e+00 - val_loss: 9.0833 - val_rm
se: 9.0833 - val_r2_keras: -9.0051e-01
Epoch 202/300

Epoch 00202: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.8555 - rmse: 10.8555 - r2_keras: -1.5741e+00 - val_loss: 5.6514 - val_rm
se: 5.6514 - val_r2_keras: 0.2231
Epoch 203/300

Epoch 00203: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.9052 - rmse: 10.9052 - r2_keras: -1.8332e+00 - val_loss: 11.6001 - val_r
mse: 11.6001 - val_r2_keras: -1.5593e+00
Epoch 204/300

Epoch 00204: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.9715 - rmse: 10.9715 - r2_keras: -2.1068e+00 - val_loss: 7.1872 - val_rm
se: 7.1872 - val_r2_keras: -1.2588e-01
Epoch 205/300

Epoch 00205: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 11.2093 - rmse: 11.2093 - r2_keras: -1.9764e+00 - val_loss: 5.2860 - val_rm
se: 5.2860 - val_r2_keras: 0.3432
Epoch 206/300

Epoch 00206: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 11.0820 - rmse: 11.0820 - r2_keras: -2.1229e+00 - val_loss: 6.6432 - val_rm
se: 6.6432 - val_r2_keras: 0.1104
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Epoch 207/300

Epoch 00207: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.8351 - rmse: 10.8351 - r2_keras: -2.3296e+00 - val_loss: 21.7979 - val_r
mse: 21.7979 - val_r2_keras: -9.1539e+00
Epoch 208/300

Epoch 00208: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 11.2315 - rmse: 11.2315 - r2_keras: -1.7861e+00 - val_loss: 7.8478 - val_rm
se: 7.8478 - val_r2_keras: -2.8814e-01
Epoch 209/300

Epoch 00209: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.9437 - rmse: 10.9437 - r2_keras: -2.3144e+00 - val_loss: 15.9406 - val_r
mse: 15.9406 - val_r2_keras: -1.8797e+01
Epoch 210/300

Epoch 00210: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.1154 - rmse: 11.1155 - r2_keras: -2.9009e+00 - val_loss: 20.8329 - val_r
mse: 20.8329 - val_r2_keras: -5.8355e+00
Epoch 211/300

Epoch 00211: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 11.1934 - rmse: 11.1934 - r2_keras: -3.9958e+00 - val_loss: 5.0782 - val_rm
se: 5.0782 - val_r2_keras: 0.3599
Epoch 212/300

Epoch 00212: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.6108 - rmse: 10.6109 - r2_keras: -1.3803e+00 - val_loss: 6.3881 - val_rm
se: 6.3881 - val_r2_keras: -4.5181e-02
Epoch 213/300

Epoch 00213: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.0454 - rmse: 11.0454 - r2_keras: -2.0231e+00 - val_loss: 9.9741 - val_rm
se: 9.9741 - val_r2_keras: -1.4684e+00
Epoch 214/300

Epoch 00214: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.7053 - rmse: 10.7052 - r2_keras: -1.6411e+00 - val_loss: 8.4419 - val_rm
se: 8.4419 - val_r2_keras: -6.9947e-01
Epoch 215/300

Epoch 00215: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.9787 - rmse: 10.9786 - r2_keras: -2.1766e+00 - val_loss: 16.1240 - val_r
mse: 16.1240 - val_r2_keras: -4.7430e+00
Epoch 216/300

Epoch 00216: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.2355 - rmse: 11.2355 - r2_keras: -2.1599e+00 - val_loss: 5.8107 - val_rm
se: 5.8107 - val_r2_keras: 0.2282
Epoch 217/300

Epoch 00217: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 11.0434 - rmse: 11.0434 - r2_keras: -2.9862e+00 - val_loss: 10.5882 - val_r
mse: 10.5882 - val_r2_keras: -1.6173e+00
Epoch 218/300

Epoch 00218: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.9152 - rmse: 10.9152 - r2_keras: -2.0239e+00 - val_loss: 15.1946 - val_r
mse: 15.1946 - val_r2_keras: -4.3723e+00
Epoch 219/300

Epoch 00219: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.9674 - rmse: 10.9674 - r2_keras: -3.2684e+00 - val_loss: 8.8792 - val_rm
se: 8.8792 - val_r2_keras: -3.7554e+01
Epoch 220/300

Epoch 00220: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.2168 - rmse: 11.2168 - r2_keras: -2.0371e+00 - val_loss: 9.4242 - val_rm
se: 9.4242 - val_r2_keras: -8.4700e-01
Epoch 221/300

Epoch 00221: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.4673 - rmse: 10.4673 - r2_keras: -1.5282e+00 - val_loss: 11.5335 - val_r
mse: 11.5335 - val_r2_keras: -2.4083e+00
Epoch 222/300
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Epoch 00222: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.7503 - rmse: 10.7503 - r2_keras: -1.4656e+00 - val_loss: 14.7232 - val_r
mse: 14.7232 - val_r2_keras: -3.4815e+00
Epoch 223/300

Epoch 00223: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.7994 - rmse: 10.7994 - r2_keras: -2.0401e+00 - val_loss: 18.6460 - val_r
mse: 18.6460 - val_r2_keras: -1.0697e+01
Epoch 224/300

Epoch 00224: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.8259 - rmse: 10.8259 - r2_keras: -1.6652e+00 - val_loss: 5.9796 - val_rm
se: 5.9796 - val_r2_keras: 0.1498
Epoch 225/300

Epoch 00225: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.9249 - rmse: 10.9249 - r2_keras: -2.0425e+00 - val_loss: 5.1404 - val_rm
se: 5.1404 - val_r2_keras: 0.3466
Epoch 226/300

Epoch 00226: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 11.0063 - rmse: 11.0063 - r2_keras: -2.0586e+00 - val_loss: 6.0172 - val_rm
se: 6.0172 - val_r2_keras: -9.6076e-02
Epoch 227/300

Epoch 00227: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.2397 - rmse: 11.2397 - r2_keras: -1.8733e+00 - val_loss: 10.2356 - val_r
mse: 10.2356 - val_r2_keras: -1.1343e+00
Epoch 228/300

Epoch 00228: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.6342 - rmse: 10.6342 - r2_keras: -2.6756e+00 - val_loss: 5.9797 - val_rm
se: 5.9797 - val_r2_keras: 0.0465
Epoch 229/300

Epoch 00229: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 11.1946 - rmse: 11.1946 - r2_keras: -2.3478e+00 - val_loss: 10.5664 - val_r
mse: 10.5664 - val_r2_keras: -1.1498e+00
Epoch 230/300

Epoch 00230: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.7703 - rmse: 10.7703 - r2_keras: -1.7728e+00 - val_loss: 4.9690 - val_rm
se: 4.9690 - val_r2_keras: 0.3697
Epoch 231/300

Epoch 00231: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.7801 - rmse: 10.7801 - r2_keras: -2.5029e+00 - val_loss: 5.7423 - val_rm
se: 5.7423 - val_r2_keras: 0.0992
Epoch 232/300

Epoch 00232: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 11.0501 - rmse: 11.0500 - r2_keras: -2.4078e+00 - val_loss: 12.0637 - val_r
mse: 12.0637 - val_r2_keras: -2.2900e+00
Epoch 233/300

Epoch 00233: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.5787 - rmse: 10.5787 - r2_keras: -1.5456e+00 - val_loss: 5.3268 - val_rm
se: 5.3268 - val_r2_keras: 0.3084
Epoch 234/300

Epoch 00234: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.9743 - rmse: 10.9743 - r2_keras: -2.2308e+00 - val_loss: 9.8520 - val_rm
se: 9.8520 - val_r2_keras: -1.5780e+00
Epoch 235/300

Epoch 00235: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.6428 - rmse: 10.6428 - r2_keras: -1.5996e+00 - val_loss: 6.7567 - val_rm
se: 6.7567 - val_r2_keras: -2.4538e-01
Epoch 236/300

Epoch 00236: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.9648 - rmse: 10.9648 - r2_keras: -1.6758e+00 - val_loss: 8.6108 - val_rm
se: 8.6108 - val_r2_keras: -9.7459e-01
Epoch 237/300

Epoch 00237: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.4461 - rmse: 10.4461 - r2_keras: -1.5481e+00 - val_loss: 13.1119 - val_r
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mse: 13.1119 - val_r2_keras: -3.5756e+01
Epoch 238/300

Epoch 00238: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.3862 - rmse: 10.3861 - r2_keras: -1.7421e+00 - val_loss: 6.9721 - val_rm
se: 6.9721 - val_r2_keras: -2.1823e-01
Epoch 239/300

Epoch 00239: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.6464 - rmse: 10.6464 - r2_keras: -2.0187e+00 - val_loss: 9.0424 - val_rm
se: 9.0424 - val_r2_keras: -7.3265e-01
Epoch 240/300

Epoch 00240: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.6872 - rmse: 10.6872 - r2_keras: -2.2709e+00 - val_loss: 21.4908 - val_r
mse: 21.4908 - val_r2_keras: -8.6098e+00
Epoch 241/300

Epoch 00241: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.8454 - rmse: 10.8454 - r2_keras: -1.6771e+00 - val_loss: 20.6343 - val_r
mse: 20.6343 - val_r2_keras: -7.2661e+00
Epoch 242/300

Epoch 00242: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.6231 - rmse: 10.6231 - r2_keras: -1.6340e+00 - val_loss: 5.5085 - val_rm
se: 5.5085 - val_r2_keras: 0.3184
Epoch 243/300

Epoch 00243: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.0923 - rmse: 10.0923 - r2_keras: -1.3773e+00 - val_loss: 5.4004 - val_rm
se: 5.4004 - val_r2_keras: -1.2559e+00
Epoch 244/300

Epoch 00244: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.5988 - rmse: 10.5988 - r2_keras: -1.4840e+00 - val_loss: 11.1755 - val_r
mse: 11.1755 - val_r2_keras: -2.5667e+00
Epoch 245/300

Epoch 00245: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.5621 - rmse: 10.5621 - r2_keras: -1.8099e+00 - val_loss: 6.3822 - val_rm
se: 6.3822 - val_r2_keras: 0.0338
Epoch 246/300

Epoch 00246: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.6427 - rmse: 10.6427 - r2_keras: -2.2049e+00 - val_loss: 4.8417 - val_rm
se: 4.8417 - val_r2_keras: 0.4153
Epoch 247/300

Epoch 00247: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.4742 - rmse: 10.4742 - r2_keras: -2.2901e+00 - val_loss: 10.0726 - val_r
mse: 10.0726 - val_r2_keras: -2.5396e+00
Epoch 248/300

Epoch 00248: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.2604 - rmse: 10.2604 - r2_keras: -1.5603e+00 - val_loss: 15.9756 - val_r
mse: 15.9756 - val_r2_keras: -5.0770e+00
Epoch 249/300

Epoch 00249: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.2693 - rmse: 10.2693 - r2_keras: -1.3791e+00 - val_loss: 18.7545 - val_r
mse: 18.7545 - val_r2_keras: -5.7734e+00
Epoch 250/300

Epoch 00250: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.5867 - rmse: 10.5867 - r2_keras: -1.7266e+00 - val_loss: 8.1636 - val_rm
se: 8.1636 - val_r2_keras: -1.6623e+00
Epoch 251/300

Epoch 00251: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.4859 - rmse: 10.4859 - r2_keras: -1.6544e+00 - val_loss: 4.7317 - val_rm
se: 4.7317 - val_r2_keras: 0.3620
Epoch 252/300

Epoch 00252: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.5019 - rmse: 10.5019 - r2_keras: -3.0850e+00 - val_loss: 5.3710 - val_rm
se: 5.3710 - val_r2_keras: 0.2259
Epoch 253/300
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Epoch 253/300

Epoch 00253: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.5437 - rmse: 10.5437 - r2_keras: -1.7553e+00 - val_loss: 8.2224 - val_rm
se: 8.2224 - val_r2_keras: -6.8513e-01
Epoch 254/300

Epoch 00254: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.3212 - rmse: 10.3213 - r2_keras: -1.5184e+00 - val_loss: 8.6956 - val_rm
se: 8.6956 - val_r2_keras: -1.3982e+00
Epoch 255/300

Epoch 00255: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.7181 - rmse: 10.7181 - r2_keras: -4.1426e+00 - val_loss: 5.3181 - val_rm
se: 5.3181 - val_r2_keras: 0.2545
Epoch 256/300

Epoch 00256: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.4249 - rmse: 10.4249 - r2_keras: -1.9614e+00 - val_loss: 5.6805 - val_rm
se: 5.6805 - val_r2_keras: 0.2135
Epoch 257/300

Epoch 00257: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.4145 - rmse: 10.4145 - r2_keras: -1.2732e+01 - val_loss: 5.0848 - val_rm
se: 5.0848 - val_r2_keras: 0.4540
Epoch 258/300

Epoch 00258: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.2635 - rmse: 10.2635 - r2_keras: -2.5792e+00 - val_loss: 4.9491 - val_rm
se: 4.9491 - val_r2_keras: 0.4724
Epoch 259/300

Epoch 00259: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.3539 - rmse: 10.3539 - r2_keras: -1.8513e+00 - val_loss: 5.3813 - val_rm
se: 5.3813 - val_r2_keras: 0.2445
Epoch 260/300

Epoch 00260: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.7287 - rmse: 10.7287 - r2_keras: -1.4627e+00 - val_loss: 7.1488 - val_rm
se: 7.1488 - val_r2_keras: -3.6442e-01
Epoch 261/300

Epoch 00261: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.5424 - rmse: 10.5424 - r2_keras: -1.6742e+00 - val_loss: 13.6940 - val_r
mse: 13.6940 - val_r2_keras: -4.5952e+00
Epoch 262/300

Epoch 00262: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.6160 - rmse: 10.6160 - r2_keras: -1.6598e+00 - val_loss: 9.0969 - val_rm
se: 9.0969 - val_r2_keras: -7.8157e-01
Epoch 263/300

Epoch 00263: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.6069 - rmse: 10.6069 - r2_keras: -2.1813e+00 - val_loss: 15.0779 - val_r
mse: 15.0779 - val_r2_keras: -6.1890e+00
Epoch 264/300

Epoch 00264: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.3460 - rmse: 10.3460 - r2_keras: -1.9934e+00 - val_loss: 5.6763 - val_rm
se: 5.6763 - val_r2_keras: 0.2036
Epoch 265/300

Epoch 00265: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.1531 - rmse: 10.1531 - r2_keras: -1.2582e+00 - val_loss: 5.8628 - val_rm
se: 5.8628 - val_r2_keras: 0.2418
Epoch 266/300

Epoch 00266: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.3271 - rmse: 10.3271 - r2_keras: -1.5606e+00 - val_loss: 6.3658 - val_rm
se: 6.3658 - val_r2_keras: -1.4218e-02
Epoch 267/300

Epoch 00267: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.2422 - rmse: 10.2422 - r2_keras: -1.3204e+00 - val_loss: 6.0288 - val_rm
se: 6.0288 - val_r2_keras: 0.1712
Epoch 268/300

Epoch 00268: val_r2_keras did not improve from 0.49050
```

```
Epoch 00268: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.5578 - rmse: 10.5578 - r2_keras: -1.5753e+00 - val_loss: 9.7669 - val_rm
se: 9.7669 - val_r2_keras: -2.0627e+00
Epoch 269/300

Epoch 00269: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.1408 - rmse: 10.1408 - r2_keras: -1.6028e+00 - val_loss: 5.6227 - val_rm
se: 5.6227 - val_r2_keras: 0.1005
Epoch 270/300

Epoch 00270: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.0848 - rmse: 10.0848 - r2_keras: -2.2506e+00 - val_loss: 5.3473 - val_rm
se: 5.3473 - val_r2_keras: 0.0305
Epoch 271/300

Epoch 00271: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.3706 - rmse: 10.3706 - r2_keras: -1.2425e+00 - val_loss: 7.3386 - val_rm
se: 7.3386 - val_r2_keras: -4.6975e-01
Epoch 272/300

Epoch 00272: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.3017 - rmse: 10.3017 - r2_keras: -2.4092e+00 - val_loss: 5.0767 - val_rm
se: 5.0767 - val_r2_keras: 0.2135
Epoch 273/300

Epoch 00273: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.4064 - rmse: 10.4064 - r2_keras: -1.6700e+00 - val_loss: 9.1558 - val_rm
se: 9.1558 - val_r2_keras: -3.4607e+00
Epoch 274/300

Epoch 00274: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.2000 - rmse: 10.2000 - r2_keras: -1.4769e+00 - val_loss: 9.5566 - val_rm
se: 9.5566 - val_r2_keras: -1.5842e+00
Epoch 275/300

Epoch 00275: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.3152 - rmse: 10.3152 - r2_keras: -1.4843e+00 - val_loss: 5.0840 - val_rm
se: 5.0840 - val_r2_keras: 0.1685
Epoch 276/300

Epoch 00276: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.1801 - rmse: 10.1801 - r2_keras: -7.0178e+00 - val_loss: 7.3129 - val_rm
se: 7.3129 - val_r2_keras: -2.8409e-01
Epoch 277/300

Epoch 00277: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.2125 - rmse: 10.2125 - r2_keras: -1.4838e+00 - val_loss: 7.2874 - val_rm
se: 7.2874 - val_r2_keras: -2.2403e-01
Epoch 278/300

Epoch 00278: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.4550 - rmse: 10.4550 - r2_keras: -2.5359e+00 - val_loss: 10.3630 - val_r
mse: 10.3630 - val_r2_keras: -1.0408e+00
Epoch 279/300

Epoch 00279: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.2856 - rmse: 10.2856 - r2_keras: -1.3181e+00 - val_loss: 5.4821 - val_rm
se: 5.4821 - val_r2_keras: 0.3697
Epoch 280/300

Epoch 00280: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.3439 - rmse: 10.3439 - r2_keras: -2.1114e+00 - val_loss: 7.6532 - val_rm
se: 7.6532 - val_r2_keras: -2.1232e-01
Epoch 281/300

Epoch 00281: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.4690 - rmse: 10.4690 - r2_keras: -1.3428e+00 - val_loss: 5.5616 - val_rm
se: 5.5616 - val_r2_keras: 0.3006
Epoch 282/300

Epoch 00282: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.3331 - rmse: 10.3331 - r2_keras: -1.3111e+00 - val_loss: 5.6553 - val_rm
se: 5.6553 - val_r2_keras: 0.1359
Epoch 283/300

Epoch 00283: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.0852 - rmse: 10.0852 - r2_keras: -1.4683e+00 - val_loss: 9.9995 - val_rm
se: 9.9995 - val_r2_keras: -1.1487e+00
```

```
se: 9.9995 - val_r2_keras: -1.1487e+00
Epoch 284/300

Epoch 00284: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 9.8544 - rmse: 9.8544 - r2_keras: -1.3591e+00 - val_loss: 11.8217 - val_rms
e: 11.8217 - val_r2_keras: -7.1876e+00
Epoch 285/300

Epoch 00285: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.2110 - rmse: 10.2110 - r2_keras: -1.4895e+00 - val_loss: 12.1467 - val_r
mse: 12.1467 - val_r2_keras: -2.1480e+00
Epoch 286/300

Epoch 00286: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.0802 - rmse: 10.0802 - r2_keras: -2.5465e+00 - val_loss: 5.0486 - val_rm
se: 5.0486 - val_r2_keras: 0.1676
Epoch 287/300

Epoch 00287: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 9.8045 - rmse: 9.8045 - r2_keras: -1.5922e+00 - val_loss: 4.7856 - val_rmse
: 4.7856 - val_r2_keras: -2.7833e+00
Epoch 288/300

Epoch 00288: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.2430 - rmse: 10.2430 - r2_keras: -1.4918e+00 - val_loss: 5.7036 - val_rm
se: 5.7036 - val_r2_keras: 0.2432
Epoch 289/300

Epoch 00289: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.2361 - rmse: 10.2361 - r2_keras: -1.4739e+00 - val_loss: 10.5808 - val_r
mse: 10.5808 - val_r2_keras: -1.8942e+00
Epoch 290/300

Epoch 00290: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 9.7887 - rmse: 9.7887 - r2_keras: -1.2125e+00 - val_loss: 4.9522 - val_rmse
: 4.9522 - val_r2_keras: 0.3395
Epoch 291/300

Epoch 00291: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 9.8271 - rmse: 9.8271 - r2_keras: -1.2527e+00 - val_loss: 9.5010 - val_rmse
: 9.5010 - val_r2_keras: -8.1861e-01
Epoch 292/300

Epoch 00292: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 9.8082 - rmse: 9.8082 - r2_keras: -1.8150e+00 - val_loss: 4.8487 - val_rmse
: 4.8487 - val_r2_keras: 0.3400
Epoch 293/300

Epoch 00293: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.0526 - rmse: 10.0526 - r2_keras: -1.4024e+00 - val_loss: 14.9380 - val_r
mse: 14.9380 - val_r2_keras: -3.2615e+00
Epoch 294/300

Epoch 00294: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 9.9557 - rmse: 9.9557 - r2_keras: -1.3356e+00 - val_loss: 5.2221 - val_rmse
: 5.2221 - val_r2_keras: 0.2445
Epoch 295/300

Epoch 00295: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 10.0846 - rmse: 10.0846 - r2_keras: -1.5894e+00 - val_loss: 5.3258 - val_rm
se: 5.3258 - val_r2_keras: 0.4455
Epoch 296/300

Epoch 00296: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 9.8434 - rmse: 9.8434 - r2_keras: -1.2119e+00 - val_loss: 6.3371 - val_rmse
: 6.3371 - val_r2_keras: -5.5660e-02
Epoch 297/300

Epoch 00297: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 9.9096 - rmse: 9.9096 - r2_keras: -1.4343e+00 - val_loss: 6.5503 - val_rmse
: 6.5503 - val_r2_keras: -4.4128e-02
Epoch 298/300

Epoch 00298: val_r2_keras did not improve from 0.49050
3367/3367 - 3s - loss: 9.7278 - rmse: 9.7278 - r2_keras: -1.2597e+00 - val_loss: 19.5121 - val_rms
e: 19.5121 - val_r2_keras: -1.2676e+01
Epoch 299/300
```

```
Epoch 00299: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 10.0452 - rmse: 10.0452 - r2_keras: -1.5133e+00 - val_loss: 5.0951 - val_rm
se: 5.0951 - val_r2_keras: 0.2165
Epoch 300/300

Epoch 00300: val_r2_keras did not improve from 0.49050
3367/3367 - 2s - loss: 9.7661 - rmse: 9.7661 - r2_keras: -1.1925e+00 - val_loss: 12.9917 - val_rms
e: 12.9917 - val_r2_keras: -2.3424e+00
```

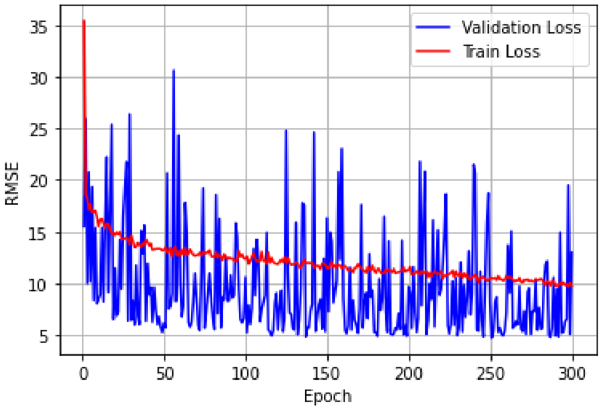
In [57]:

```
score = model_adam.evaluate(decomposed_train, actual_y, verbose=0)
print('Train RMSE:', score[0])

fig,ax = plt.subplots(1,1)
ax.set_xlabel('Epoch')
ax.set_ylabel('RMSE')
x = list(range(1,300+1))

vy = model.history['val_loss']
ty = model.history['loss']
plt_dynamic(x, vy, ty, ax)
```

```
Train RMSE: 9.249127602118385
```

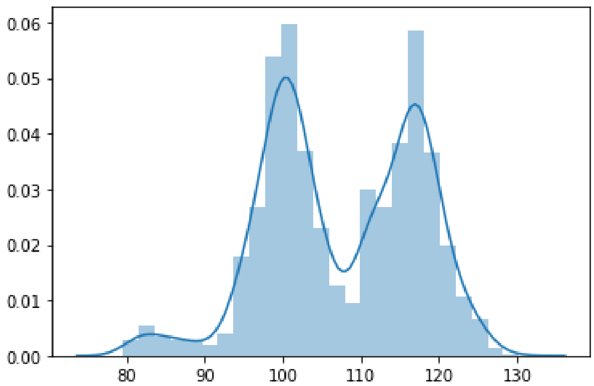


In [59]:

```
sns.distplot(model_adam.predict(decomposed_test))
```

Out[59]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fe3e5fca0b8>
```



In [0]:

```
sub = pd.DataFrame()
sub['ID'] = test['ID']
sub['y'] = model_adam.predict(decomposed_test)
sub.to_csv('/content/gdrive/My Drive/SelfCaseStudy/submission_Final.csv', index=False)
```

SUMMARY OF FULL CASE STUDY

<!DOCTYPE html>

MODEL SUMMARY

ATTEMPT 1

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
1.	LASSO REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .6	0.58	7.761	0.51926
2.	RIDGE REGRESSION MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .2	0.632	7.25	-14.88253
3.	ELASTICNET MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	ALPHA = .9	0.58	7.70	0.51776
4.	LASSOLARS MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Normalize = TRUE	0.60	7.576	0.523
5.	DECISIONTREE MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multi-Parameters	0.645	7.128	.53772
6.	SVR MODEL	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	C value : 1	.52	8.24	No
7.	XGBOOST	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Mupliple parameters	.65	7.01	.53701
8.	GBDT	LABEL ENCODING	ABOVE 150 SEC VALUES IMPUTED WITH 100	Multiple Parameters:	0.6363	7.32	.53901

ATTEMPT 2

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
8.	LASSO REGRESSION MODEL	LABEL ENCODING	REMOVED 12 UNIMPORTANT FEATURES FROM THE DATASET	ALPHA = .9	0.58	7.761	0.51926

ATTEMPT 3

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
9.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .9	0.553	8.29	0.52224
10.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = 400	0.031	12.22	0.12
11.	ELASTICNET REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	ALPHA = .7	0.573	8.10	.52685
12.	LASSOLARS MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	NORMALIZE = TRUE	0.555	8.28	.5173

13.	DECISIONTREE REGRESSOR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	0.60	7.86	.54353
14.	SVR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	C Value : 1	8.80	.495	No
15.	XGBOOST MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	--	--	--
16.	GBDT MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 100	MultiHyperparameters	--	.62	.53003

ATTEMPT 4

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
16.	LASSO REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .9	.5521	8.31	0.52215
17.	RIDGE REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.031	12.23	-
7.	ELASTICNET REGRESSION MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .7	0.572	8.12	.52693-
18.	LASSOLARS MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .7	0.59	8.104	.53496-
19.	DECISIONTREE REGRESSOR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	Mutli-Parameters	0.60	7.86	.54356
20.	SVR MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	C = .7	0.49	8.8	.42905-
21.	GBDT MODEL	LABEL ENCODING	iMPUTED 265.32 ONLY WITH 130	Multiple parameters	.5921	8.01	.5421-

ATTEMPT 5

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
21.	LASSO MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = .09	0.58	8.04	.53174-
22.	RIDGE MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.035	12.20	--
23.	ELASTICNET MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.577	8.08	.52921
24.	LARSLASSO MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	ALPHA = 400	0.566	8.17	.52329
25.	DECISION TREE MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	Multi parameters	0.59	8.17	.54356
26.	XGBOOST MODEL	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	Multi parameters	0.62	7.52	.5356
25.	GBDT REGRESSOR	ONE HOT ENCODING	iMPUTED 265.32 ONLY WITH 130	Multi parameters	NO	NO	NO

ATTEMPT 6

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE

27.	LASSO MODEL	LABEL ENCODING without ID feature	iMPUTED 265.32 ONLY WITH 130	ALPHA = .09	0.58	8.00	.53370
28.	DECISION TREE MODEL	LABEL ENCODING without ID feature	iMPUTED 265.32 ONLY WITH 130	MULTIPARAMETERS	0.59	7.88	.54218
30.	LASSOLARS MODEL	LABEL ENCODING without ID feature	iMPUTED 265.32 ONLY WITH 130	NOTMALIZED = TRUE	0.54	8.37	.506

ATTEMPT 7

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
31.	LASSO REGRESSION	DECOMPOSED FEATURES	iMPUTED 265.32 ONLY WITH 130	Multi parameters	.58	8.04	.5262
32.	DECISION TREE	DECOMPOSED FEATURES	iMPUTED 265.32 ONLY WITH 130	Multi parameters	.60	7.812	.53264
34.	XGBOOST	DECOMPOSED FEATURES	iMPUTED 265.32 ONLY WITH 130	Multi parameters	--	8.002	.54167
34.	GBDT REGRESSOR	DECOMPOSED FEATURES	iMPUTED 265.32 ONLY WITH 130	Multi parameters	--	8.002	.53228

Stacking model

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
31.	Weighted AVG(Stacking model + (12 Decomposed + Original features) XGBOOST model)	LabelEncoded FEATURES	iMPUTED 265.32 ONLY WITH 130	Tried different combination and best result is :	-	-	.55241
32.	Voting Regressor TREE	DECOMPOSED FEATURES	iMPUTED 265.32 ONLY WITH 130	Not giving good result on kaggle public scoreboard	.60	8.812	.53201

Deep Learning model

SN0	Model	Encoding	Imputation	Hyperparameter	R^2 Loss	RMSE	KAGGLE PRIVATE SCORE
31.	Deep Learning model	LabelEncoded FEATURES	iMPUTED 265.32 ONLY WITH 130	Tried different combination and best result is :	.492	9.249	.48

9. Possible Further Analysis

1. We could have taken the sequencing into consideration in the analysis as Mercedes has given us the data by Random Sampling . We can think logically that one car which went before has some influence on the test time of the current Car test time.

2. We could have create some extra features by multiplying and summing some features, though we don't know how much it worth but we could have tried.