

# Ridge and Lasso Regression- Advertising

```
In [2]: import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import Ridge, RidgeCV, Lasso
from sklearn.preprocessing import StandardScaler
```

```
In [3]: #data
data=pd.read_csv(r"C:\Users\sneha\Downloads\Advertising.csv")
data
```

Out[3]:

	TV	Radio	Newspaper	Sales
0	230.1	37.8	69.2	22.1
1	44.5	39.3	45.1	10.4
2	17.2	45.9	69.3	12.0
3	151.5	41.3	58.5	16.5
4	180.8	10.8	58.4	17.9
...	...	...	...	...
195	38.2	3.7	13.8	7.6
196	94.2	4.9	8.1	14.0
197	177.0	9.3	6.4	14.8
198	283.6	42.0	66.2	25.5
199	232.1	8.6	8.7	18.4

200 rows × 4 columns

```
In [4]: data.head()
```

Out[4]:

	TV	Radio	Newspaper	Sales
0	230.1	37.8	69.2	22.1
1	44.5	39.3	45.1	10.4
2	17.2	45.9	69.3	12.0
3	151.5	41.3	58.5	16.5
4	180.8	10.8	58.4	17.9

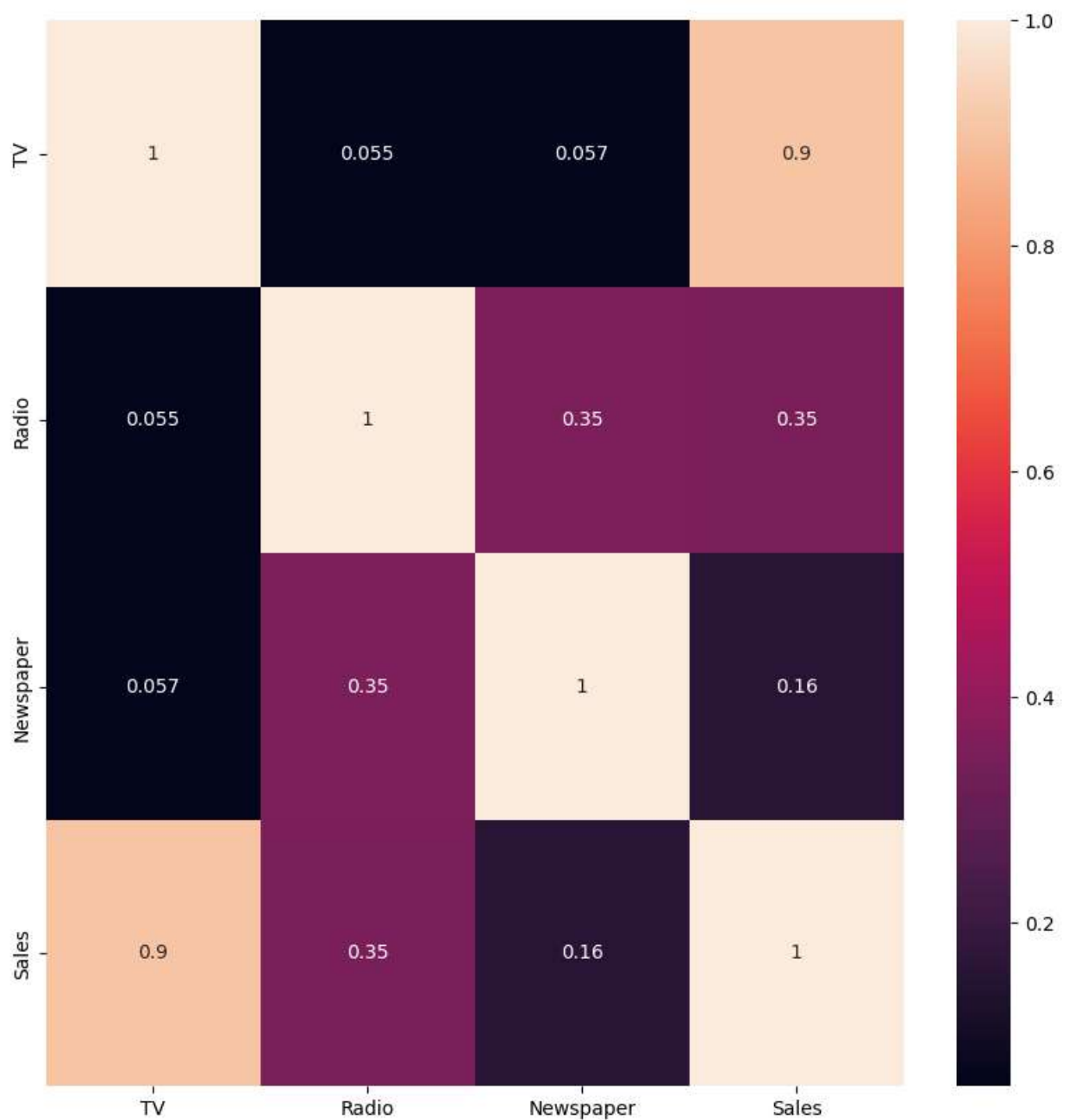
```
In [5]: data.tail()
```

```
Out[5]:
```

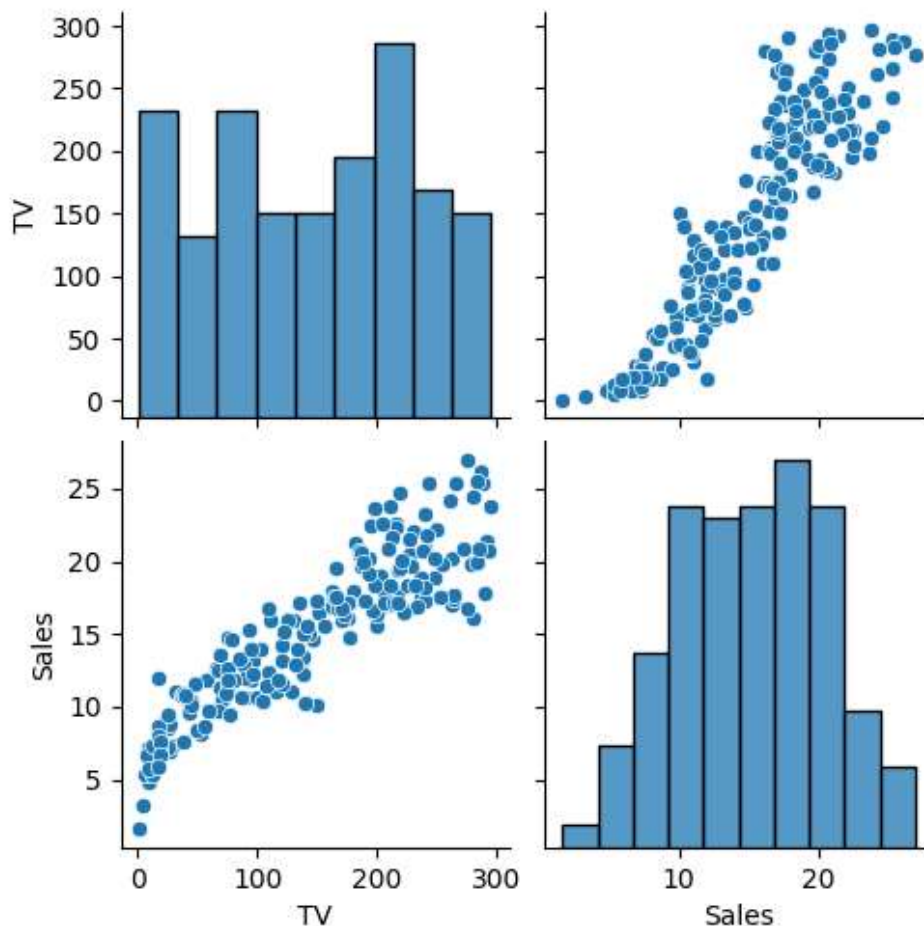
	TV	Radio	Newspaper	Sales
195	38.2	3.7	13.8	7.6
196	94.2	4.9	8.1	14.0
197	177.0	9.3	6.4	14.8
198	283.6	42.0	66.2	25.5
199	232.1	8.6	8.7	18.4

```
In [6]: plt.figure(figsize = (10, 10))  
sns.heatmap(data.corr(), annot = True)
```

```
Out[6]: <Axes: >
```



```
In [7]: data.drop(columns = ["Radio", "Newspaper"], inplace = True)
#pairplot
sns.pairplot(data)
data.Sales = np.log(data.Sales)
```



```
In [18]: features = data.columns[0:2]
target = data.columns[-1]
#X and y values
X = data[features].values
y = data[target].values
#split
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.3,
                                                    random_state=17)
print("The dimension of X_train is {}".format(X_train.shape))
print("The dimension of X_test is {}".format(X_test.shape))
#Scale features
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

The dimension of X\_train is (140, 2)

The dimension of X\_test is (60, 2)

```
In [19]: #Model
lr = LinearRegression()
#Fit model
lr.fit(X_train, y_train)
#predict
#prediction = lr.predict(X_test)
#actual
actual = y_test
train_score_lr = lr.score(X_train, y_train)
test_score_lr = lr.score(X_test, y_test)
print("\nLinear Regression Model:\n")
print("The train score for lr model is {}".format(train_score_lr))
print("The test score for lr model is {}".format(test_score_lr))
```

Linear Regression Model:

The train score for lr model is 1.0

The test score for lr model is 1.0

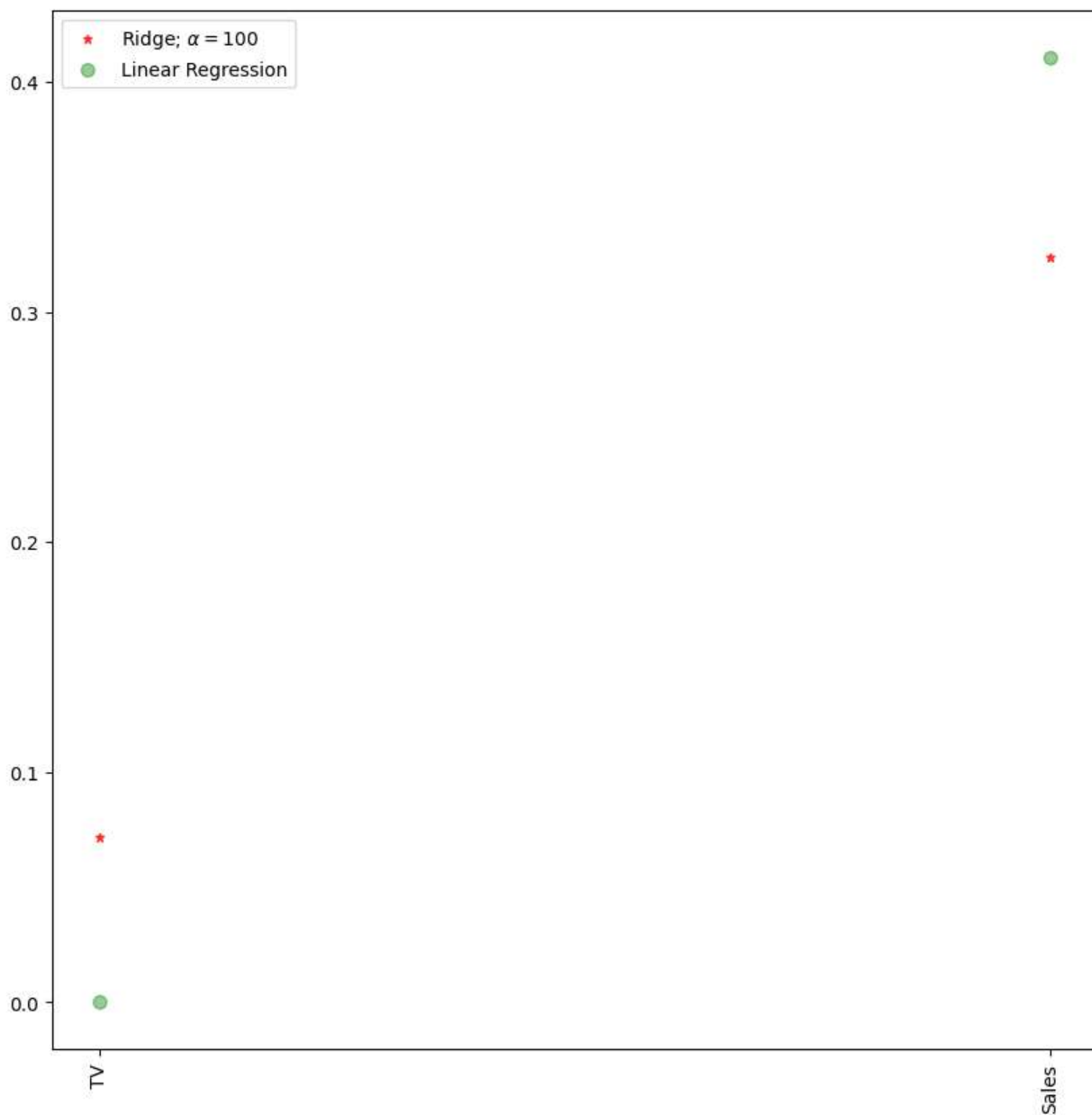
```
In [20]: #Ridge Regression Model
ridgeReg = Ridge(alpha=10)
ridgeReg.fit(X_train,y_train)
#train and test scorefor ridge regression
train_score_ridge = ridgeReg.score(X_train, y_train)
test_score_ridge = ridgeReg.score(X_test, y_test)
print("\nRidge Model:\n")
print("The train score for ridge model is {}".format(train_score_ridge))
print("The test score for ridge model is {}".format(test_score_ridge))
```

Ridge Model:

The train score for ridge model is 0.9902871391941609

The test score for ridge model is 0.984426628514122

```
In [21]: plt.figure(figsize = (10, 10))
plt.plot(features,ridgeReg.coef_,alpha=0.7,linestyle='none',marker='*',
         markersize=5,color='red',label=r'Ridge;  $\alpha = 100$ ')
#plt.plot(rr100.coef_,alpha=0.5,linestyle='none',marker='d',markersize=6,
#color='blue',label=r'Ridge;  $\alpha = 100$ ')
plt.plot(features,lr.coef_,alpha=0.4,linestyle='none',marker='o',
         markersize=7,color='green',label='Linear Regression')
plt.xticks(rotation = 90)
plt.legend()
plt.show()
```



```
In [22]: #Lasso regression model
print("\nLasso Model: \n")
lasso = Lasso(alpha = 10)
lasso.fit(X_train,y_train)
train_score_ls =lasso.score(X_train,y_train)
test_score_ls =lasso.score(X_test,y_test)
print("The train score for ls model is {}".format(train_score_ls))
print("The test score for ls model is {}".format(test_score_ls))
```

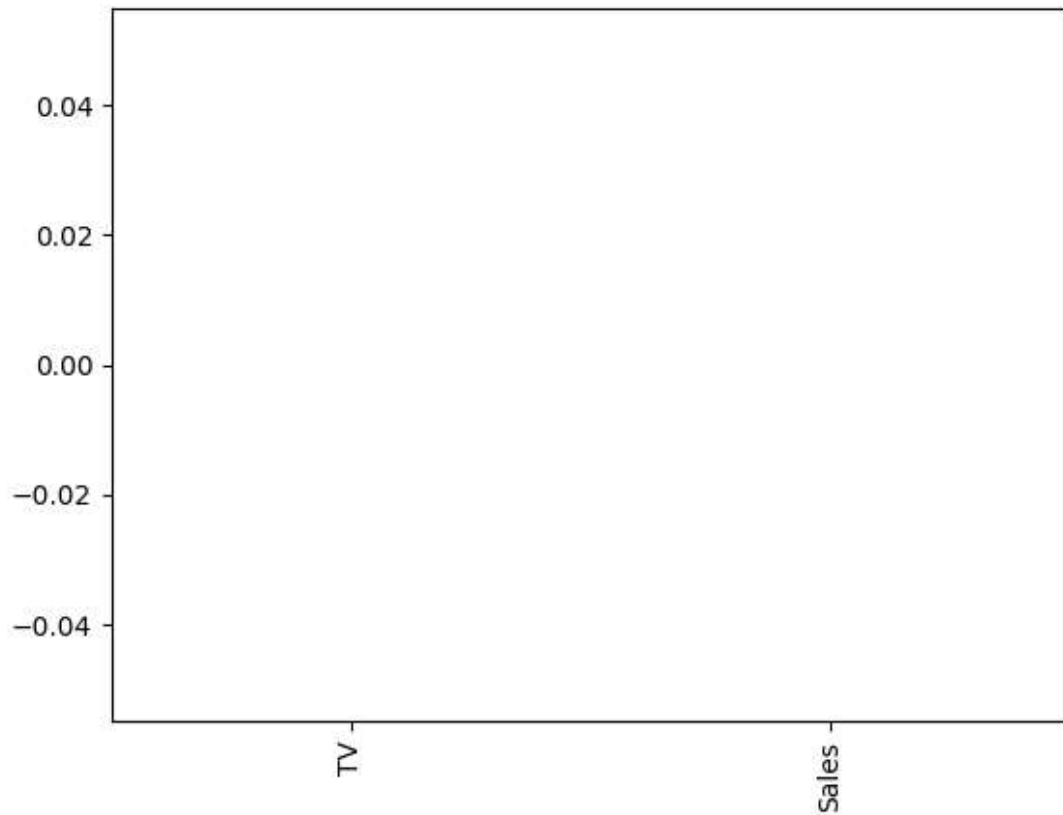
Lasso Model:

The train score for ls model is 0.0

The test score for ls model is -0.0042092253233847465

```
In [23]: pd.Series(lasso.coef_,features).sort_values(ascending=True).plot(kind="bar")
```

Out[23]: <Axes: >



```
In [24]: #Using the linear CV model
from sklearn.linear_model import LassoCV
#Lasso Cross validation
lasso_cv = LassoCV(alphas = [0.0001, 0.001,0.01, 0.1, 1, 10],
                    random_state=0).fit(X_train, y_train)
#score
print(lasso_cv.score(X_train,y_train))
print(lasso_cv.score(X_test,y_test))
```

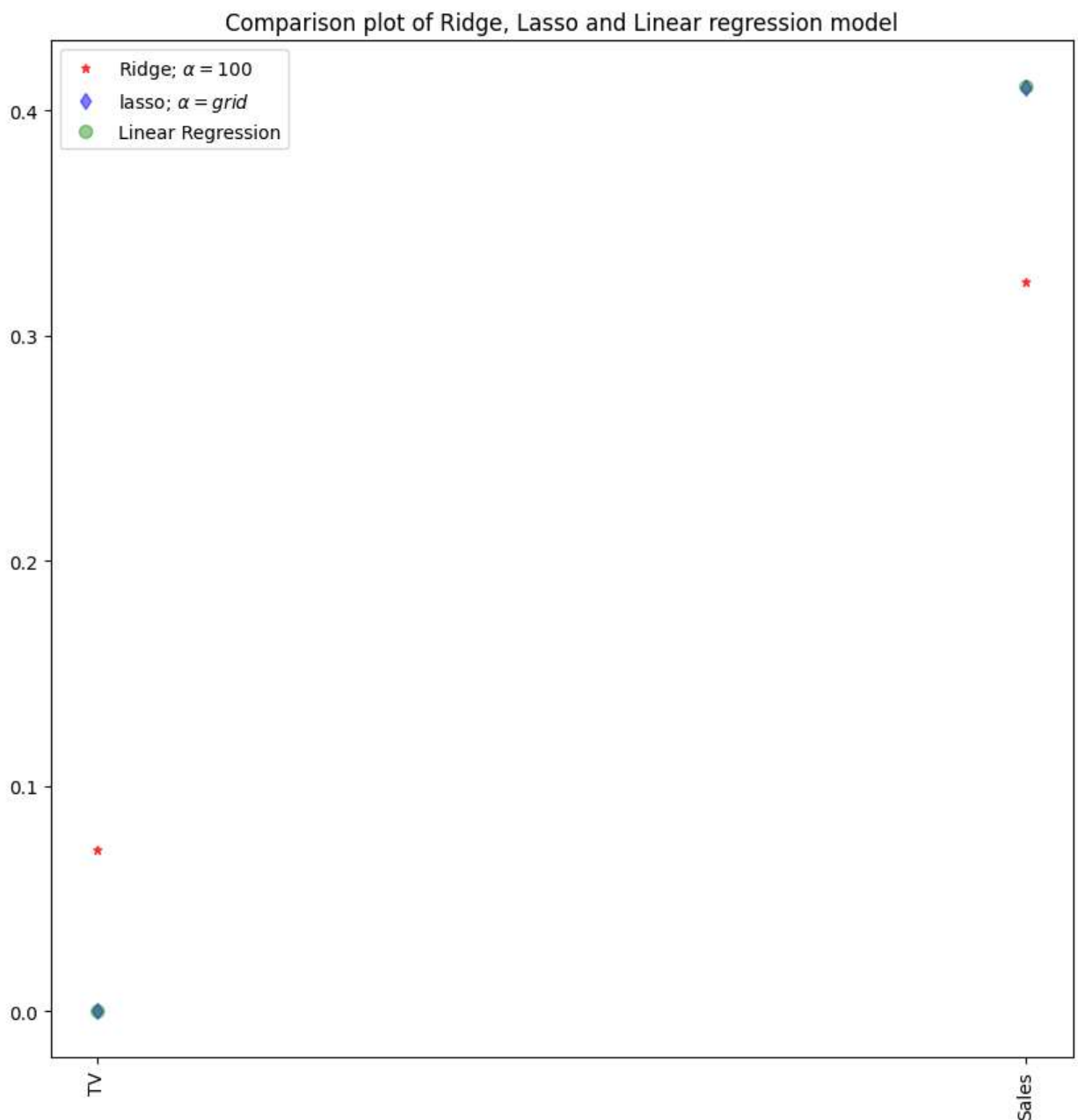
0.9999999343798134

0.9999999152638072

```

In [25]: #plot size
plt.figure(figsize = (10, 10))
#add plot for ridge regression
plt.plot(features,ridgeReg.coef_,alpha=0.7,linestyle='none',marker='*',
          markersize=5,color='red',label=r'Ridge; $\alpha=100$')
#add plot for lasso regression
plt.plot(lasso_cv.coef_,alpha=0.5,linestyle='none',marker='d',
          markersize=6,color='blue',label=r'lasso; $\alpha = \text{grid}$')
#add plot for linear model
plt.plot(features,lr.coef_,alpha=0.4,linestyle='none',marker='o',
          markersize=7,color='green',label='Linear Regression')
#rotate axis
plt.xticks(rotation = 90)
plt.legend()
plt.title("Comparison plot of Ridge, Lasso and Linear regression model")
plt.show()

```



```
In [32]: #Using the linear CV model
from sklearn.linear_model import RidgeCV
#Ridge Cross validation
ridge_cv=RidgeCV(alphas=[0.0001,0.001,0.01,0.1,1,10]).fit(X_train,y_train)
#score
print("The train score for ridge model is {}".format(ridge_cv.score(X_train,y_train)))
print("The train score for ridge model is {}".format(ridge_cv.score(X_test,y_test)))
```

The train score for ridge model is 0.99999999997627  
The train score for ridge model is 0.999999999962466

## ELASTIC NET

```
In [28]: from sklearn.linear_model import ElasticNet
regr = ElasticNet()
regr.fit(X,y)
print(regr.coef_)
print(regr.intercept_)
```

```
[0.00417976 0.          ]
2.026383919311004
```

```
In [30]: y_pred_elastic = regr.predict(X_train)
```

```
In [31]: mean_squared_error = np.mean((y_pred_elastic-y_train)**2)
print("Mean squared Error on test set",mean_squared_error)
```

Mean squared Error on test set 0.5538818050142158

## Vehicle selection

```
In [33]: import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import Ridge, RidgeCV, Lasso
from sklearn.preprocessing import StandardScaler
```



```
In [34]: #data
data=pd.read_csv(r"C:\Users\sneha\Downloads\fiat500_VehicleSelection_Dataset (2).csv")
data
```

Out[34]:

	ID	model	engine_power	age_in_days	km	previous_owners	lat	lon	price
0	1	lounge	51	882	25000	1	44.907242	8.611560	8900
1	2	pop	51	1186	32500	1	45.666359	12.241890	8800
2	3	sport	74	4658	142228	1	45.503300	11.417840	4200
3	4	lounge	51	2739	160000	1	40.633171	17.634609	6000
4	5	pop	73	3074	106880	1	41.903221	12.495650	5700
...	...	...	...	...	...	...	...	...	...
1533	1534	sport	51	3712	115280	1	45.069679	7.704920	5200
1534	1535	lounge	74	3835	112000	1	45.845692	8.666870	4600
1535	1536	pop	51	2223	60457	1	45.481541	9.413480	7500
1536	1537	lounge	51	2557	80750	1	45.000702	7.682270	5990
1537	1538	pop	51	1766	54276	1	40.323410	17.568270	7900

1538 rows × 9 columns

```
In [39]: data = data[['engine_power','price']]
data.columns=['Eng','pri']
```

```
In [35]: data.head()
```

Out[35]:

	ID	model	engine_power	age_in_days	km	previous_owners	lat	lon	price
0	1	lounge	51	882	25000	1	44.907242	8.611560	8900
1	2	pop	51	1186	32500	1	45.666359	12.241890	8800
2	3	sport	74	4658	142228	1	45.503300	11.417840	4200
3	4	lounge	51	2739	160000	1	40.633171	17.634609	6000
4	5	pop	73	3074	106880	1	41.903221	12.495650	5700

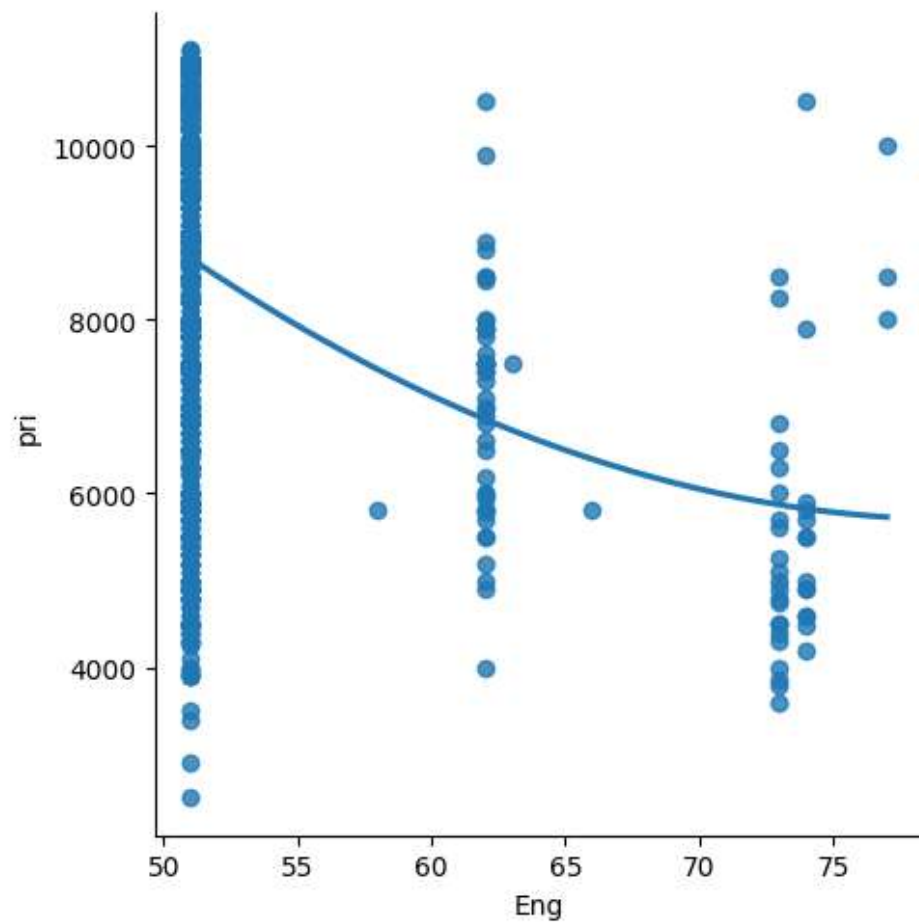
```
In [36]: data.tail()
```

Out[36]:

	ID	model	engine_power	age_in_days	km	previous_owners	lat	lon	price
1533	1534	sport	51	3712	115280	1	45.069679	7.70492	5200
1534	1535	lounge	74	3835	112000	1	45.845692	8.66687	4600
1535	1536	pop	51	2223	60457	1	45.481541	9.41348	7500
1536	1537	lounge	51	2557	80750	1	45.000702	7.68227	5990
1537	1538	pop	51	1766	54276	1	40.323410	17.56827	7900

```
In [40]: sns.lmplot(x='Eng',y='pri',data=data,order=2,ci=None)
```

```
Out[40]: <seaborn.axisgrid.FacetGrid at 0x167df2b3880>
```



```
In [41]: data.info()
data.describe()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1538 entries, 0 to 1537
Data columns (total 2 columns):
 #   Column  Non-Null Count  Dtype  
---  --
 0    Eng     1538 non-null    int64  
 1    pri     1538 non-null    int64  
dtypes: int64(2)
memory usage: 24.2 KB
```

```
Out[41]:
```

	Eng	pri
<b>count</b>	1538.000000	1538.000000
<b>mean</b>	51.904421	8576.003901
<b>std</b>	3.988023	1939.958641
<b>min</b>	51.000000	2500.000000
<b>25%</b>	51.000000	7122.500000
<b>50%</b>	51.000000	9000.000000
<b>75%</b>	51.000000	10000.000000
<b>max</b>	77.000000	11100.000000

```
In [42]: data.fillna(method='ffill')
```

```
Out[42]:
```

	Eng	pri
<b>0</b>	51	8900
<b>1</b>	51	8800
<b>2</b>	74	4200
<b>3</b>	51	6000
<b>4</b>	73	5700
...	...	...
<b>1533</b>	51	5200
<b>1534</b>	74	4600
<b>1535</b>	51	7500
<b>1536</b>	51	5990
<b>1537</b>	51	7900

1538 rows × 2 columns

```
In [43]: x=np.array(data['Eng']).reshape(-1,1)
y=np.array(data['pri']).reshape(-1,1)
```

```
In [44]: data.dropna(inplace=True)
```

C:\Users\sneha\AppData\Local\Temp\ipykernel\_15004\1368182302.py:1: SettingWithCopyWarning:

A value is trying to be set on a copy of a slice from a DataFrame

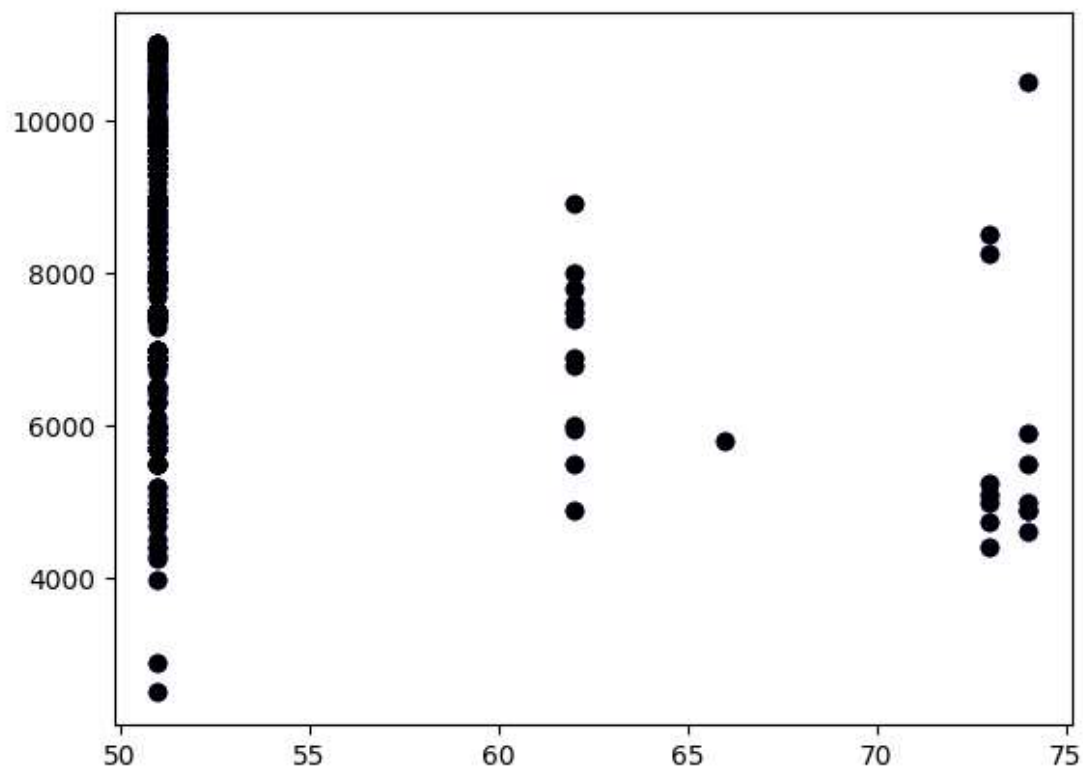
See the caveats in the documentation: [https://pandas.pydata.org/pandas-docs/stable/user\\_guide/indexing.html#returning-a-view-versus-a-copy](https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy) ([https://pandas.pydata.org/pandas-docs/stable/user\\_guide/indexing.html#returning-a-view-versus-a-copy](https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy))

```
data.dropna(inplace=True)
```

```
In [45]: X_train,X_test,y_train,y_test = train_test_split(x, y, test_size = 0.25)
# Splitting the data into training data and test data
regr = LinearRegression()
regr.fit(X_train, y_train)
print(regr.score(X_test, y_test))
```

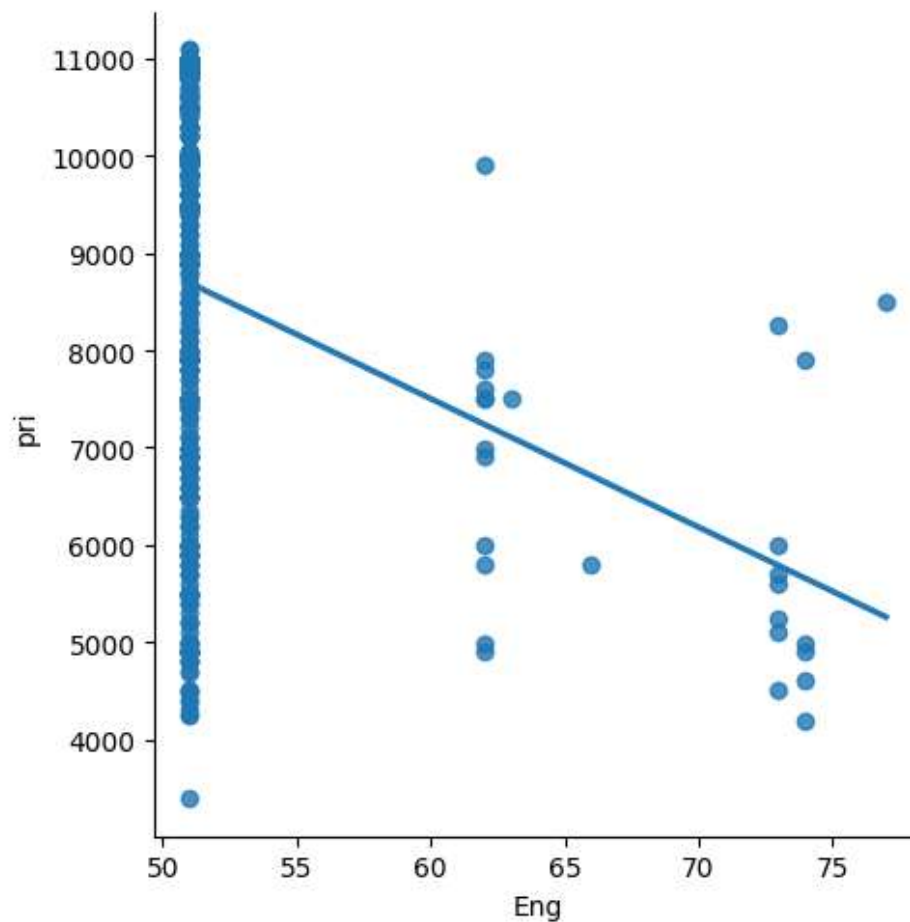
0.10416218443333636

```
In [46]: y_pred = regr.predict(X_test)
plt.scatter(X_test, y_test, color = 'b')
plt.scatter(X_test, y_test, color = 'k')
plt.show()
```



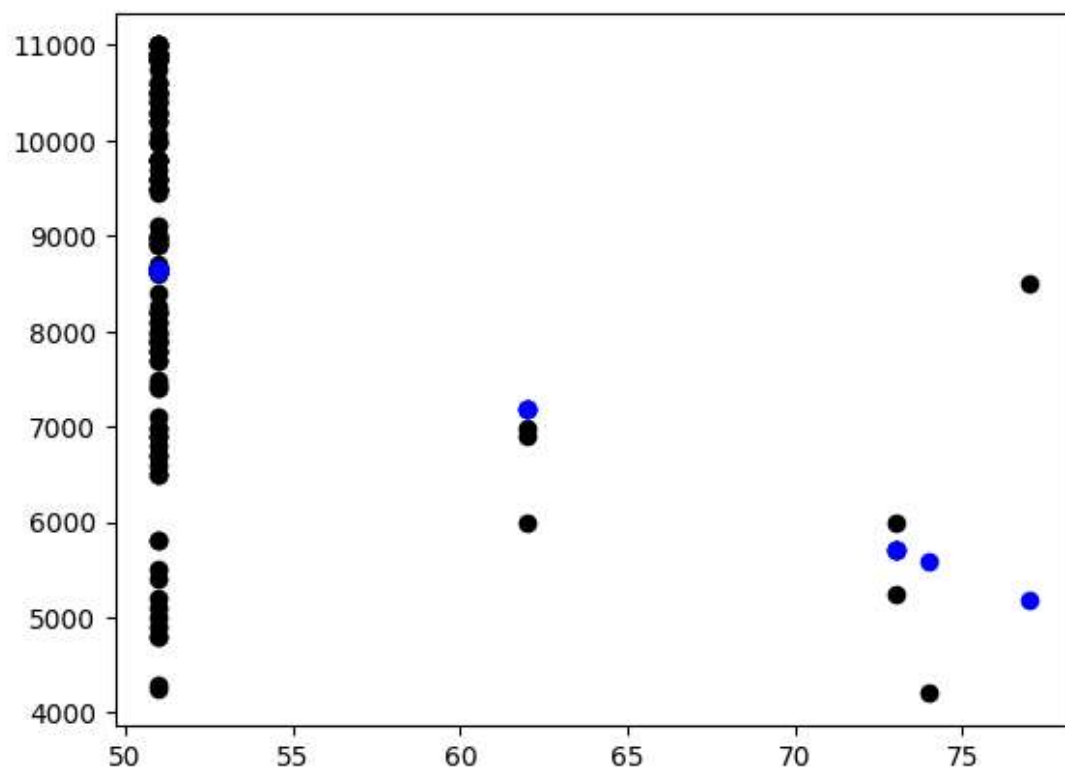
```
In [47]: df500 = data[:][:500]
# Selecting the 1st 500 rows of teh data
sns.lmplot(x = "Eng", y = "pri", data = df500, order = 1, ci = None)
```

Out[47]: <seaborn.axisgrid.FacetGrid at 0x167df52a0>



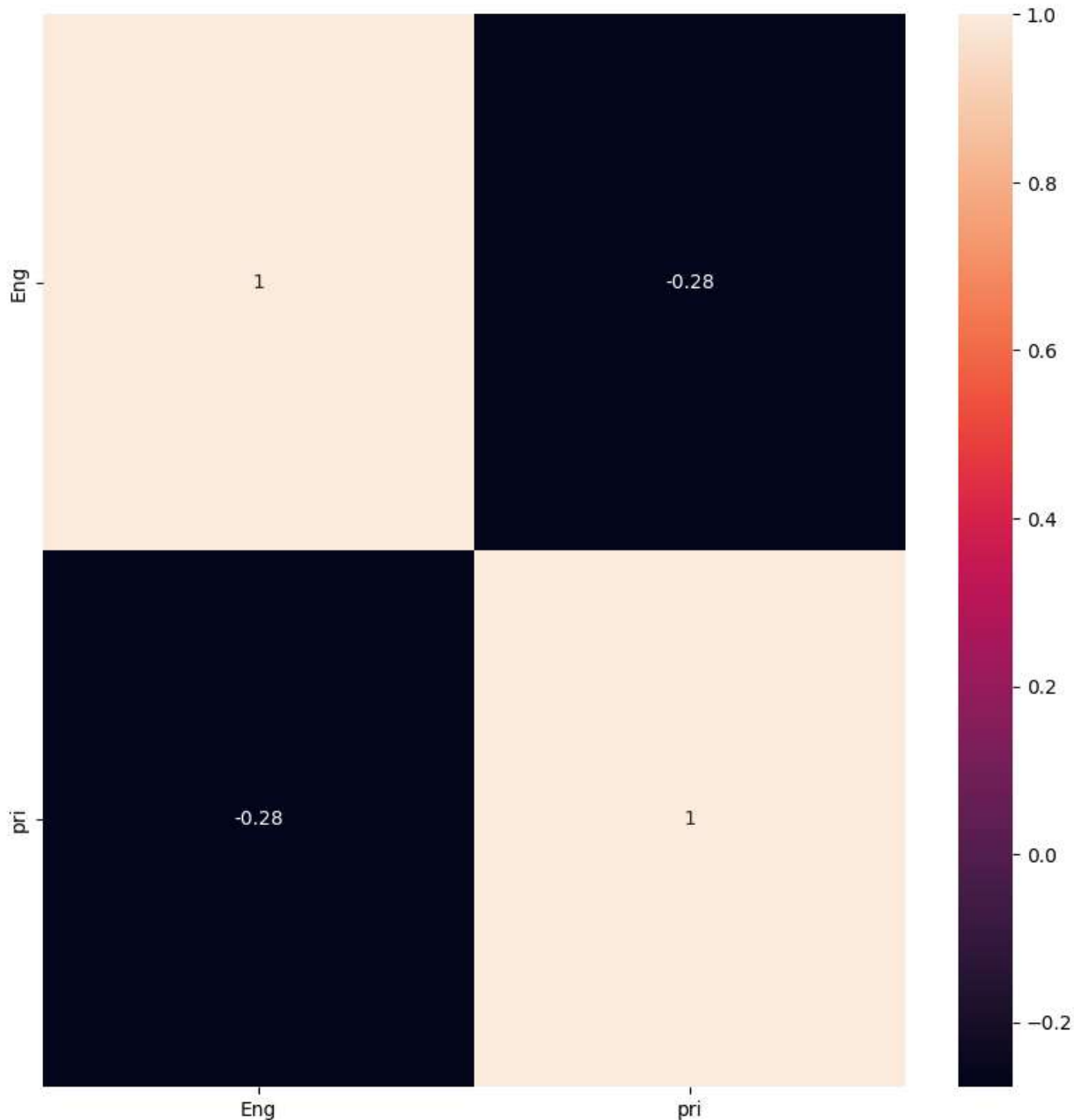
```
In [48]: df500.fillna(method = 'ffill', inplace = True)
x = np.array(df500['Eng']).reshape(-1,1)
y = np.array(df500['pri']).reshape(-1,1)
df500.dropna(inplace = True)
X_train, X_test, y_train, y_test = train_test_split(x,y,test_size = 0.25)
regr = LinearRegression()
regr.fit(X_train, y_train)
print("Regression:",regr.score(X_test, y_test))
y_pred = regr.predict(X_test)
plt.scatter(X_test, y_test, color = 'k')
plt.scatter(X_test, y_pred, color = 'b')
plt.show()
```

Regression: 0.09996326546147283



```
In [49]: plt.figure(figsize = (10, 10))  
sns.heatmap(data.corr(), annot = True)
```

Out[49]: <Axes: >



```
In [50]: from sklearn.linear_model import LinearRegression  
from sklearn.metrics import r2_score  
#Train the model  
model = LinearRegression()  
model.fit(X_train, y_train)  
#Evaluating the model on the test set  
y_pred = model.predict(X_test)  
r2 = r2_score(y_test, y_pred)  
print("R2 score:", r2)
```

R2 score: 0.09996326546147283

Linear Regression is not fit in this model

```
In [51]: #Model
lr = LinearRegression()
#Fit model
lr.fit(X_train, y_train)
#predict
#prediction = lr.predict(X_test)
#actual
actual = y_test
train_score_lr = lr.score(X_train, y_train)
test_score_lr = lr.score(X_test, y_test)
print("\nLinear Regression Model:\n")
print("The train score for lr model is {}".format(train_score_lr))
print("The test score for lr model is {}".format(test_score_lr))
```

Linear Regression Model:

The train score for lr model is 0.05927530779021295

The test score for lr model is 0.09996326546147283

```
In [52]: #Model
lr = LinearRegression()
#Fit model
lr.fit(X_train, y_train)
#predict
#prediction = lr.predict(X_test)
#actual
actual = y_test
train_score_lr = lr.score(X_train, y_train)
test_score_lr = lr.score(X_test, y_test)
print("\nLinear Regression Model:\n")
print("The train score for lr model is {}".format(train_score_lr))
print("The test score for lr model is {}".format(test_score_lr))
```

Linear Regression Model:

The train score for lr model is 0.05927530779021295

The test score for lr model is 0.09996326546147283

```
In [53]: #Lasso regression model
print("\nLasso Model: \n")
lasso = Lasso(alpha = 10)
lasso.fit(X_train,y_train)
train_score_ls =lasso.score(X_train,y_train)
test_score_ls =lasso.score(X_test,y_test)
print("The train score for ls model is {}".format(train_score_ls))
print("The test score for ls model is {}".format(test_score_ls))
```

Lasso Model:

The train score for ls model is 0.059273621960479805

The test score for ls model is 0.1000081328294059



```
In [54]: #Using the Linear CV model
from sklearn.linear_model import LassoCV
#Lasso Cross validation
lasso_cv=LassoCV(alphas=[0.0001,0.001,0.01,0.1,1,10],
                  random_state=0).fit(X_train,y_train)
#score
print(lasso_cv.score(X_train, y_train))
print(lasso_cv.score(X_test, y_test))
```

```
0.05927530779021284
0.0999632659422679
```

```
C:\Users\sneha\AppData\Local\Programs\Python\Python310\lib\site-packages\sklearn\linear_model\_coordinate_descent.py:1568: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
```

```
In [ ]:
```