Ridge and Lasso Regression

In [1]:

```
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 [2]:

```
#data
data=pd.read_csv(r"C:\Users\Teju\Downloads\Advertising.csv")
data
```

Out[2]:

	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 [3]:

```
data.head()
```

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

In [4]:

```
data.tail()
```

Out[4]:

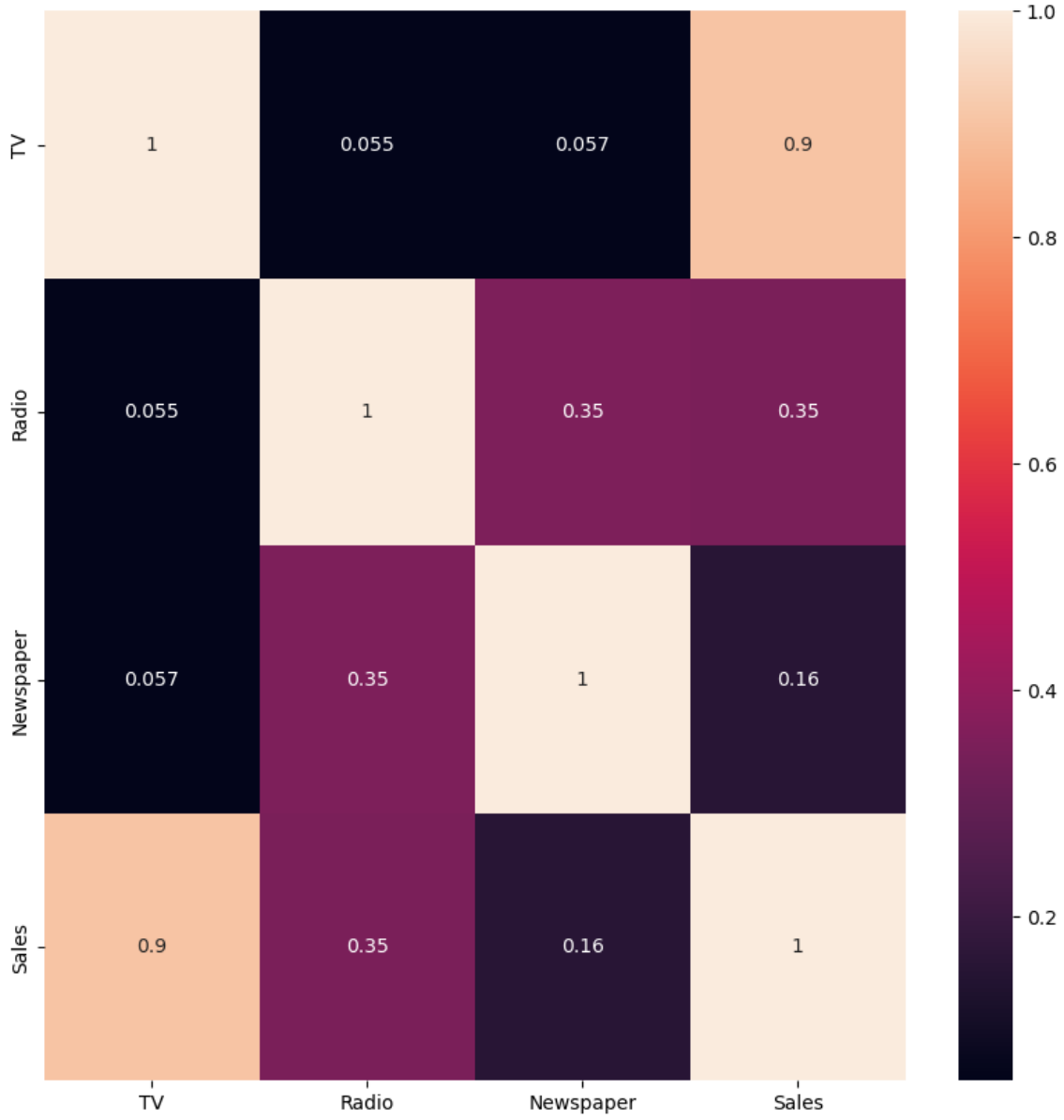
	TV	Radio	Newspaper	Sales
195	38.2	3.7	13.8	7.6
196	94.2	4.9	8.1	14.0
197	177.0	9.3	6.4	14.8
198	283.6	42.0	66.2	25.5
199	232.1	8.6	8.7	18.4

In [5]:

```
plt.figure(figsize = (10, 10))
sns.heatmap(data.corr(), annot = True)
```

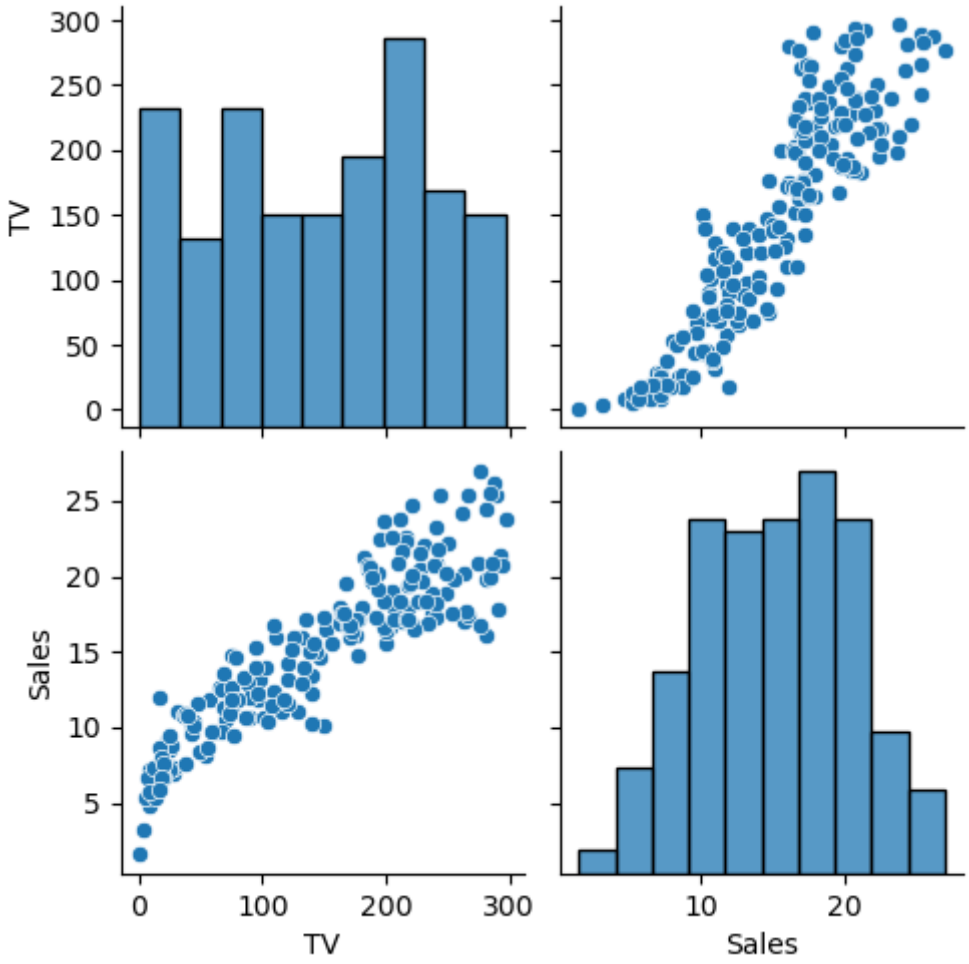
Out[5]:

<Axes: >



In [6]:

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



In [7]:

```
features = data.columns[0:2]
target = data.columns[-1]
#X and y values
X = data[features].values
y = data[target].values
#splot
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 [8]:

```
#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
```

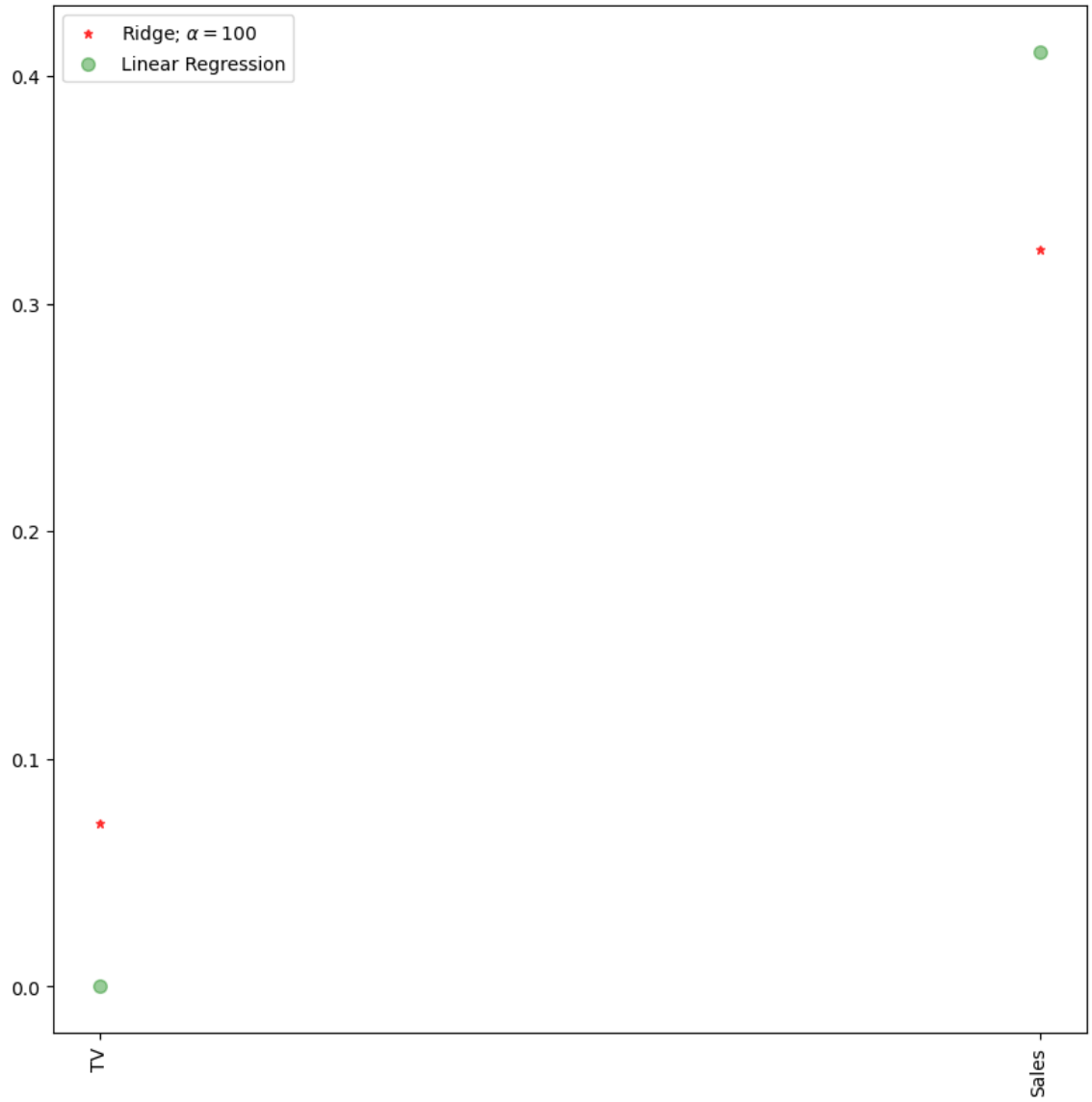
In [9]:

```
#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 0.9902871391941606
The test score for ridge model is 0.9844266285141214
```

In [10]:

```
#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,colo
#add plot for lasso regression
#plt.plot(rr100.coef_,alpha=0.5,linestyle='none',marker='d',markersize=6,color='blue',la
plt.plot(features,lr.coef_,alpha=0.4,linestyle='none',marker='o',markersize=7,color='gre
plt.xticks(rotation = 90)
plt.legend()
plt.show()
```



In [11]:

```
#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))
```

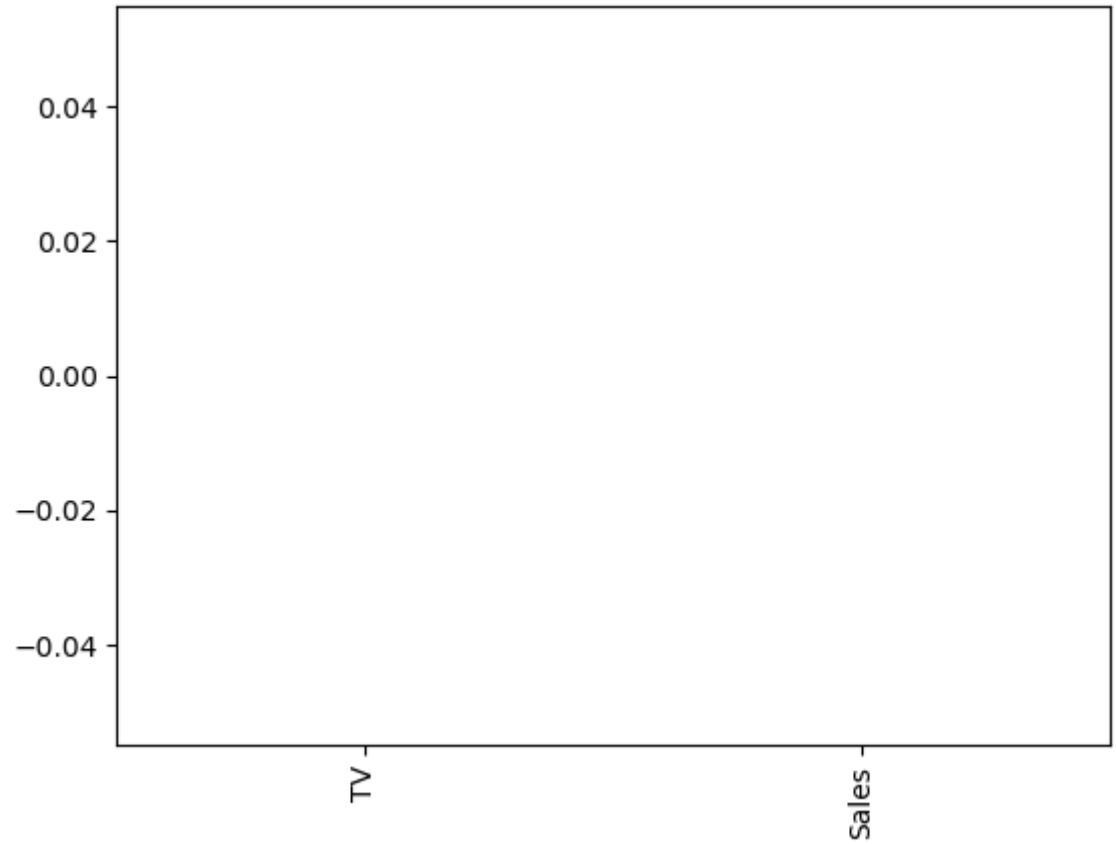
```
Lasso Model:

The train score for ls model is 0.0
The test score for ls model is -0.0042092253233847465
```

In [12]:

```
pd.Series(lasso.coef_, features).sort_values(ascending = True).plot(kind = "bar")
```

Out[12]:

```
<Axes: >
```



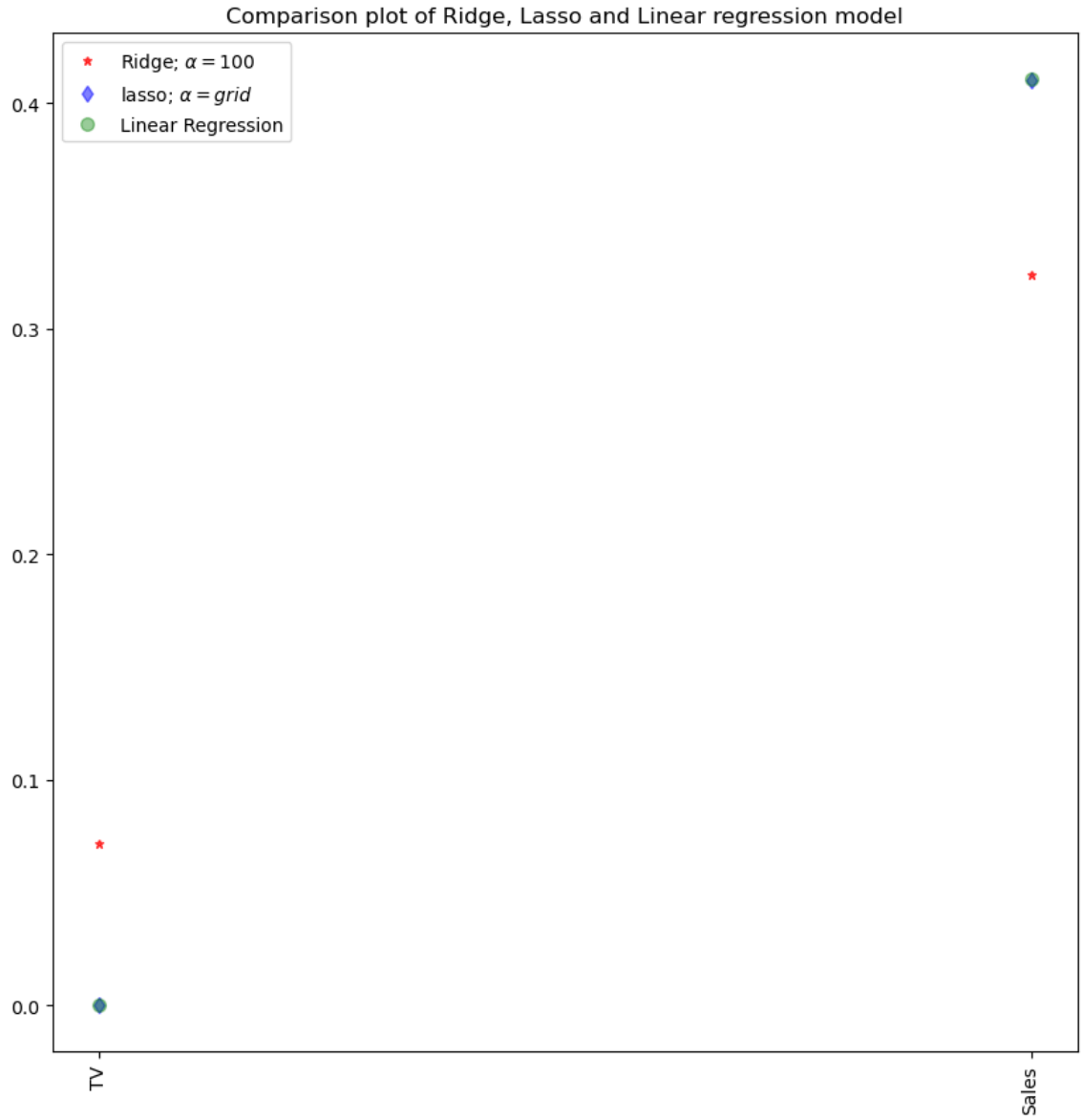
In [13]:

```
#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_trai
#score
print(lasso_cv.score(X_train, y_train))
print(lasso_cv.score(X_test, y_test))
```

```
0.9999999343798134
0.9999999152638072
```

In [14]:

```
#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,colo
#add plot for lasso regression
plt.plot(lasso_cv.coef_,alpha=0.5,linestyle='none',marker='d',markersize=6,color='blue',
#add plot for linear model
plt.plot(features,lr.coef_,alpha=0.4,linestyle='none',marker='o',markersize=7,color='gre
#rotate axis
plt.xticks(rotation = 90)
plt.legend()
plt.title("Comparison plot of Ridge, Lasso and Linear regression model")
plt.show()
```



In [15]:

```
#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 0.9999999999976276
The train score for ridge model is 0.9999999999962477
```

ElasticNet Regression

In [16]:

```
from sklearn.linear_model import ElasticNet
regr=ElasticNet()
regr.fit(X,y)
print(regr.coef_)
print(regr.intercept_)
```

```
[0.00417976 0.        ]
2.0263839193110043
```

In [17]:

```
y_pred_elastic=regr.predict(X_train)
```

In [18]:

```
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 0.5538818050142152
```

Vehicle Selection

In [19]:

```
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 [20]:

```
#data
data=pd.read_csv(r"C:\Users\Teju\Downloads\fiat500_VehicleSelection_Dataset.csv")
data
```

Out[20]:

	ID	model	engine_power	age_in_days	km	previous_owners	lat	
0	1	lounge	51	882	25000	1	44.907242	8.611
1	2	pop	51	1186	32500	1	45.666359	12.241
2	3	sport	74	4658	142228	1	45.503300	11.417
3	4	lounge	51	2739	160000	1	40.633171	17.634
4	5	pop	73	3074	106880	1	41.903221	12.495
...	...	...	...	...	...	...	...	
1533	1534	sport	51	3712	115280	1	45.069679	7.704
1534	1535	lounge	74	3835	112000	1	45.845692	8.666
1535	1536	pop	51	2223	60457	1	45.481541	9.413
1536	1537	lounge	51	2557	80750	1	45.000702	7.682
1537	1538	pop	51	1766	54276	1	40.323410	17.568

1538 rows × 9 columns

In [21]:

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

In [22]:

```
data.head()
```

Out[22]:

	Eng	pri
0	51	8900
1	51	8800
2	74	4200
3	51	6000
4	73	5700

In [23]:

```
data.tail()
```

Out[23]:

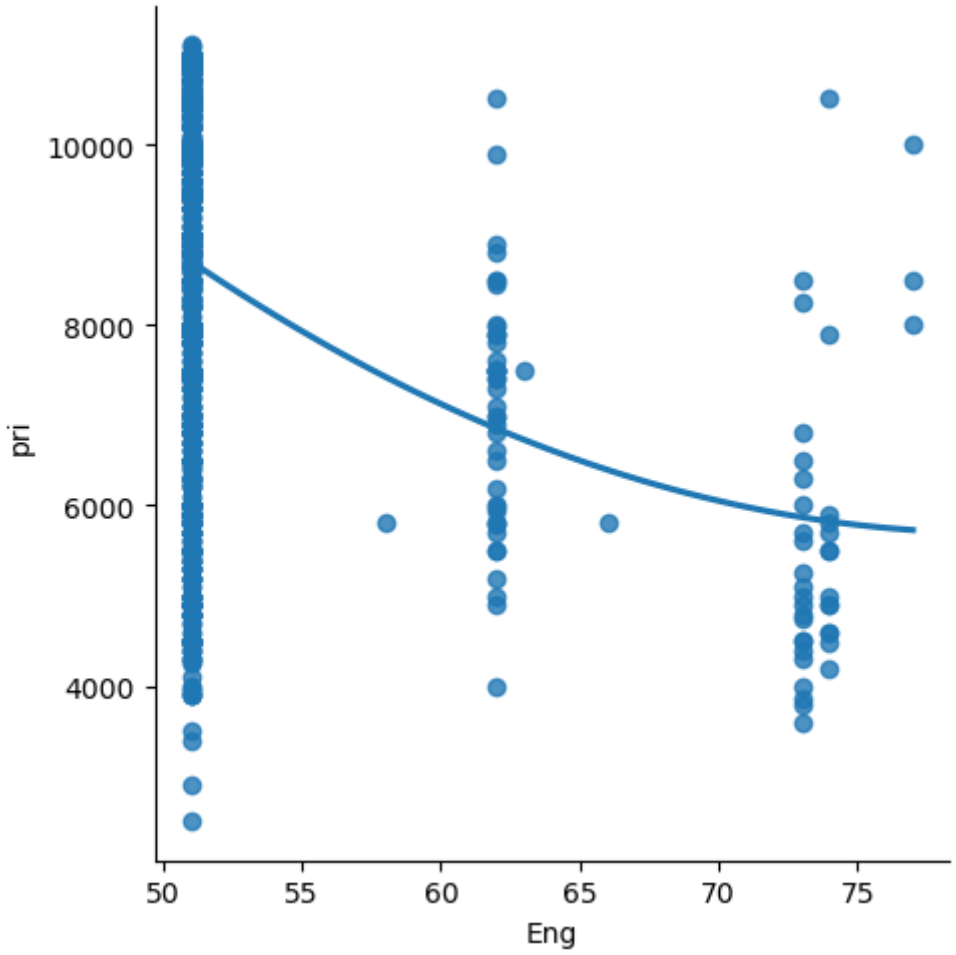
	Eng	pri
1533	51	5200
1534	74	4600
1535	51	7500
1536	51	5990
1537	51	7900

In [24]:

```
sns.lmplot(x='Eng',y='pri',data=data,order=2,ci=None)
```

Out[24]:

```
<seaborn.axisgrid.FacetGrid at 0x20a8d8d1660>
```



In [25]:

```
data.info()
```

```
<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
```

In [26]:

```
data.describe()
```

Out[26]:

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

In [27]:

```
data.fillna(method='ffill')
```

Out[27]:

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

1538 rows × 2 columns

In [28]:

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

In [29]:

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

```
C:\Users\Teju\AppData\Local\Temp\ipykernel_17364\3138178865.py:1: SettingW
ithCopyWarning:
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-doc
s/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)
```

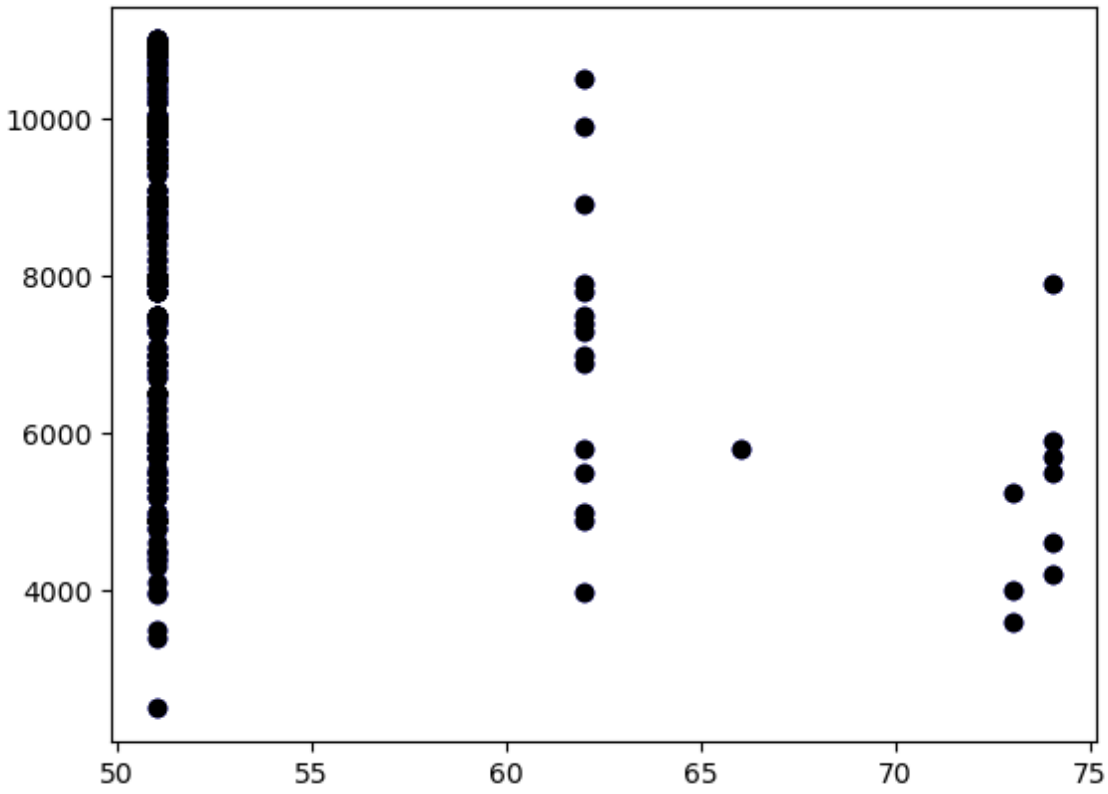
In [30]:

```
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))
```

```
0.0824658000164391
```

In [31]:

```
y_pred=regr.predict(X_test)
plt.scatter(X_test, y_test, color = 'b')
plt.scatter(X_test, y_test, color = 'k')
plt.show()
```

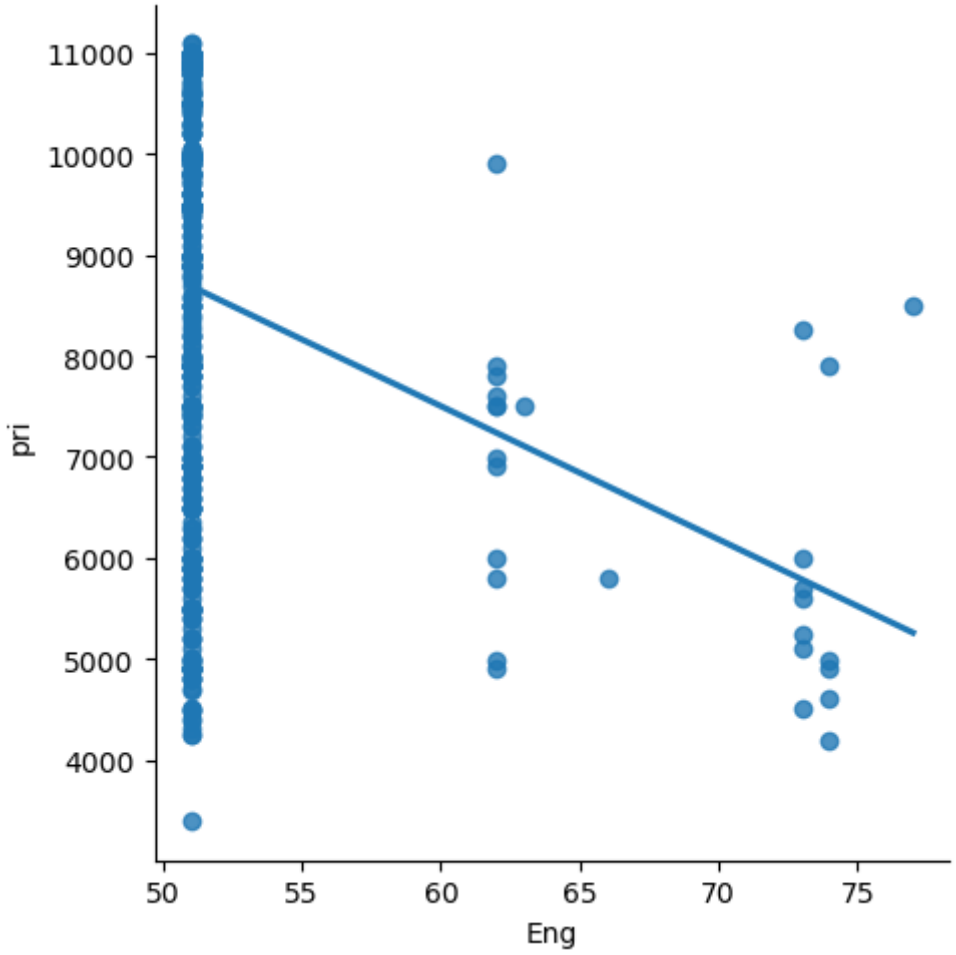


In [32]:

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

Out[32]:

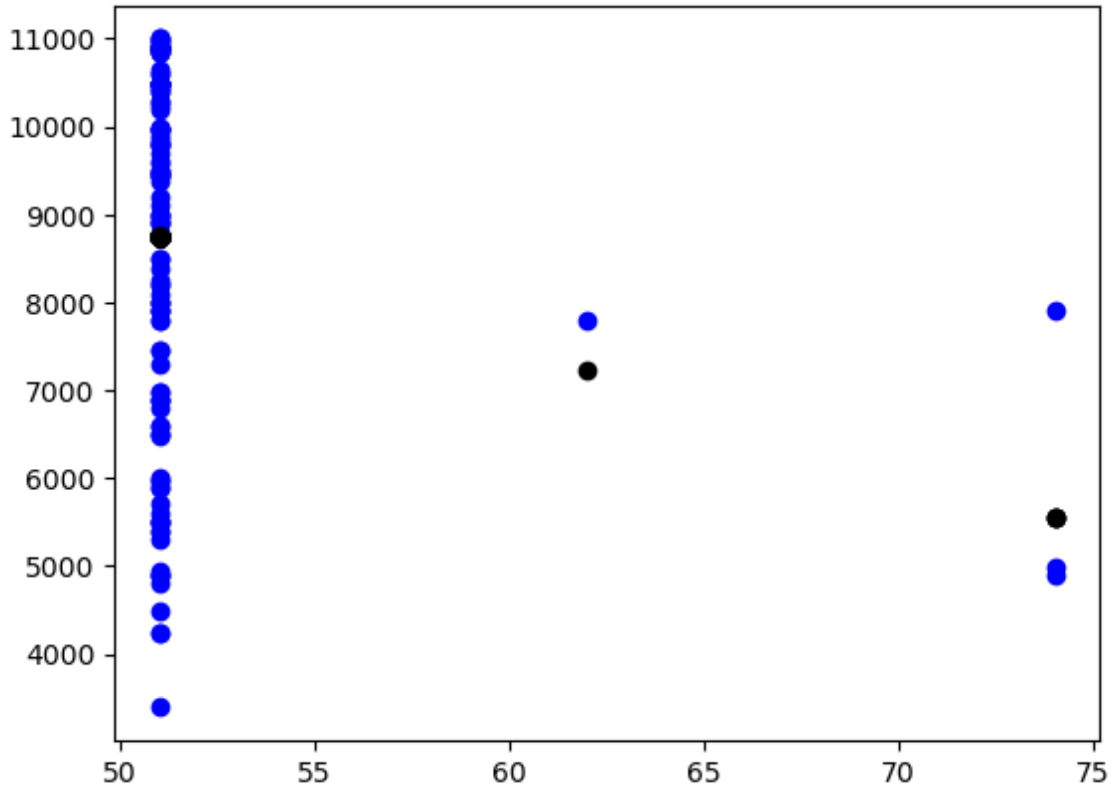
```
<seaborn.axisgrid.FacetGrid at 0x20a8e045240>
```



In [33]:

```
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)
# Splitting the data into training data and test data
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 = 'b')
plt.scatter(X_test, y_pred, color = 'k')
plt.show()
```

```
Regression: 0.028078674058233166
```

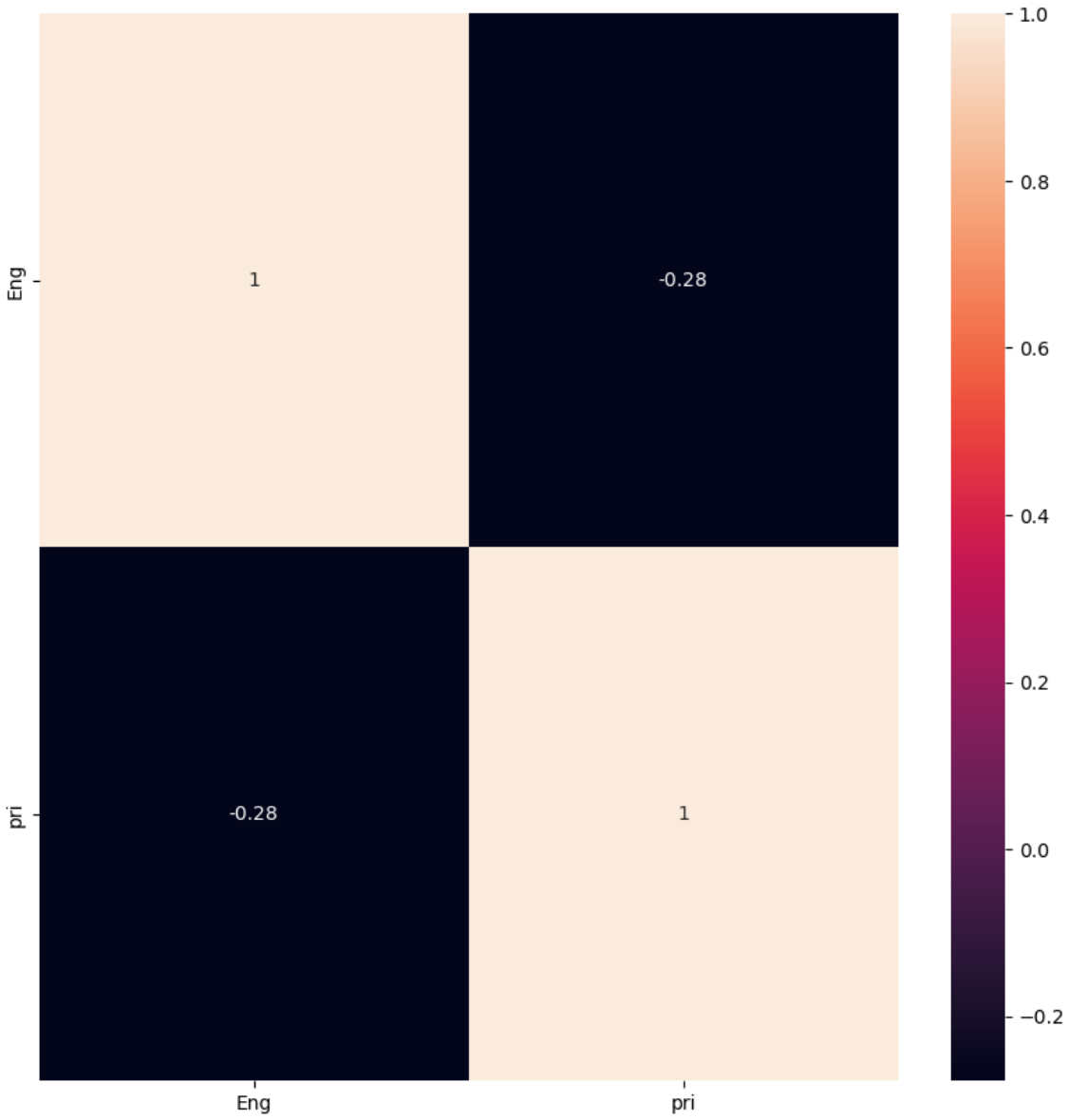


In [34]:

```
plt.figure(figsize = (10, 10))
sns.heatmap(data.corr(), annot = True)
```

Out[34]:

<Axes: >



In [35]:

```
#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 0.08211963452699622
The test score for lr model is 0.028078674058233166
```

In [36]:

```
#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 0.08211943768543661
The test score for ridge model is 0.028122337126813002
```

In [37]:

```
#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 0.0821181867077374
The test score for ls model is 0.028196419881909685
```

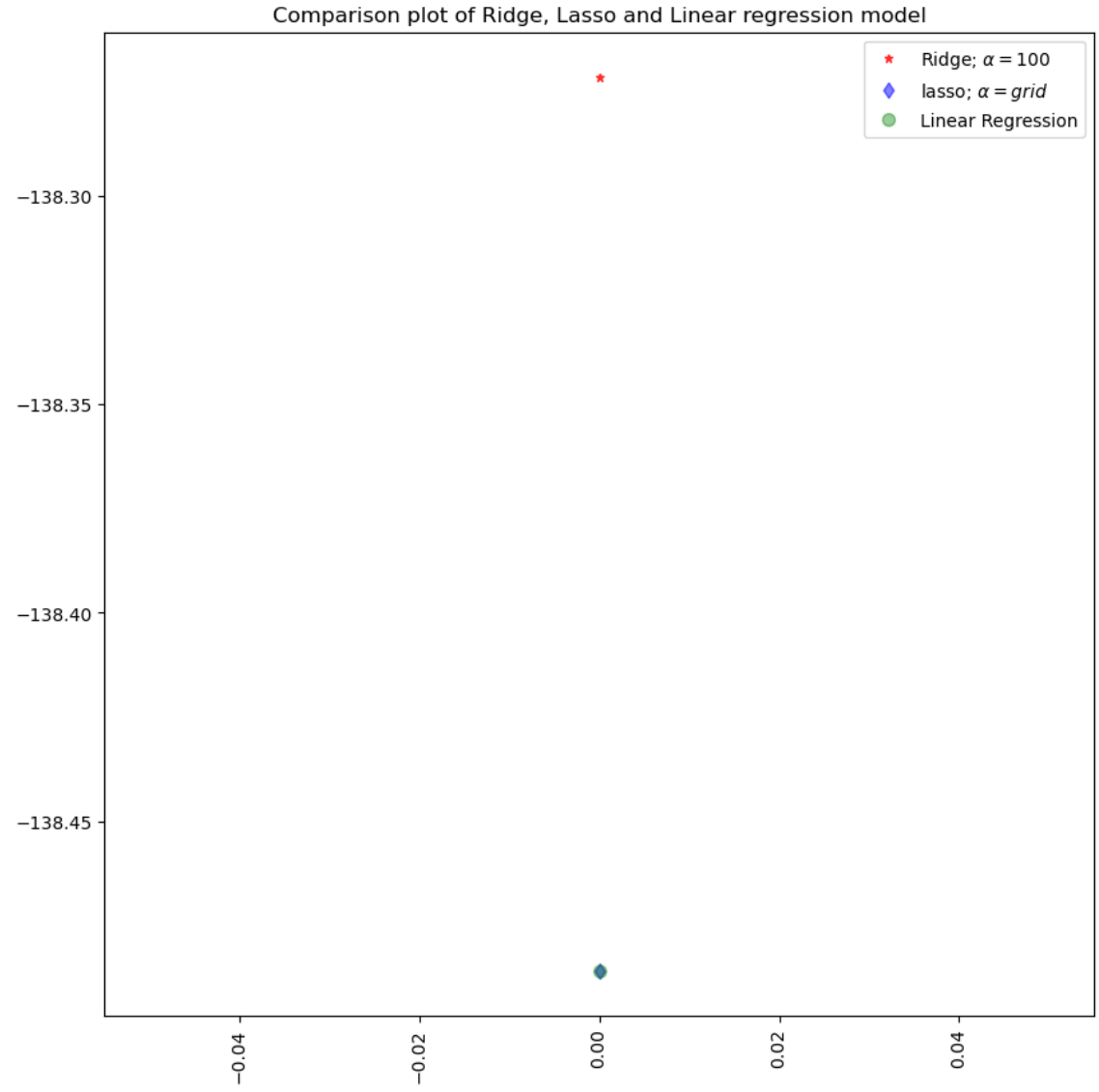
In [38]:

```
#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_trai
#score
print(lasso_cv.score(X_train, y_train))
print(lasso_cv.score(X_test, y_test))
```

```
0.08211963452699622
0.028078675246318907

C:\Users\Teju\anaconda3\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, ), fo
r example using ravel().
  y = column_or_1d(y, warn=True)
```

In [39]:

```
#plot size
plt.figure(figsize = (10, 10))
#add plot for ridge regression
plt.plot(ridgeReg.coef_,alpha=0.7,linestyle='none',marker='*',markersize=5,color='red',l
#add plot for lasso regression
plt.plot(lasso_cv.coef_,alpha=0.5,linestyle='none',marker='d',markersize=6,color='blue',
#add plot for linear model
plt.plot(lr.coef_,alpha=0.4,linestyle='none',marker='o',markersize=7,color='green',label
#rotate axis
plt.xticks(rotation = 90)
plt.legend()
plt.title("Comparison plot of Ridge, Lasso and Linear regression model")
plt.show()
```



ElasticNet Regression

In [40]:

```
from sklearn.linear_model import ElasticNet
regr=ElasticNet()
regr.fit(x,y)
print(regr.coef_)
print(regr.intercept_)
```

```
[-128.05913739]
[15219.18170389]
```

In [41]:

```
y_pred_elastic=regr.predict(X_train)
```

In [42]:

```
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 4300215.94093598
```