Linear Regression

In [20]:

```
#Importing libraries
%matplotlib inline
import numpy as np
import pandas as pd
import datetime as dt
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings("ignore")
```

In [4]:

```
# Reading files
df = pd.read_csv('nyc_taxi_trip_duration.csv')
df['pickup_datetime'] = pd.to_datetime(df.pickup_datetime)
df['dropoff_datetime'] = pd.to_datetime(df.dropoff_datetime)
df.shape
#removing outliers
df=df[df["trip_duration"]<6000]
df = df.loc[(df.pickup_latitude > 40.6) & (df.pickup_latitude < 40.9)]
df = df.loc[(df.dropoff_latitude>40.6) & (df.dropoff_latitude < 40.9)]
df = df.loc[(df.dropoff_longitude > -74.05) & (df.dropoff_longitude < -73.7)]
df = df.loc[(df.pickup_longitude > -74.05) & (df.pickup_longitude < -73.7)]
df.drop(["id","pickup_datetime","dropoff_datetime", "store_and_fwd_flag"],axis=1,inplace=True)
```

In [5]:

```
df.dtypes
```

Out[5]:

```
vendor_id              int64
passenger_count        int64
pickup_longitude     float64
pickup_latitude      float64
dropoff_longitude    float64
dropoff_latitude     float64
trip_duration          int64
dtype: object
```

In [190]:

```
df.head()
```

Out[190]:

	vendor_id	passenger_count	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	trip_duration
0	2	1	-74	41	-74	41	400
1	1	2	-74	41	-74	41	1100
2	2	2	-74	41	-74	41	1635
3	2	6	-74	41	-74	41	1141
4	1	1	-74	41	-74	41	848

In [12]:

```
#seperating independent and dependent variables
x = df.drop(['trip_duration'], axis=1)
y = df['trip_duration']
x.shape, y.shape
```

Out[12]:

```
((724984, 6), (724984,))
```

In [15]:

```
# Importing the train test split function
from sklearn.model_selection import train_test_split
train_x,test_x,train_y,test_y = train_test_split(x,y, random_state = 52)
```

In [10]:

```
#importing Linear Regression and metric mean square error
from sklearn.linear_model import LinearRegression as LR
from sklearn.metrics import mean_absolute_error as mae
```

In [16]:

```
# Creating instance of Linear Regresssion
lr = LR(normalize = True)

# Fitting the model
lr.fit(train_x, train_y)
```

Out[16]:

```
LinearRegression(normalize=True)
```

In [17]:

```
# Predicting over the Train Set and calculating error
train_predict = lr.predict(train_x)
k = mae(train_predict, train_y)
print('Training Mean Absolute Error', k )
```

```
Training Mean Absolute Error 411.2606036142575
```

In [18]:

```
# Predicting over the Test Set and calculating error
test_predict = lr.predict(test_x)
k = mae(test_predict, test_y)
print('Test Mean Absolute Error    ', k )
```

```
Test Mean Absolute Error     412.3746827539336
```

In [238]:

```
lr.coef_
```

Out[238]:

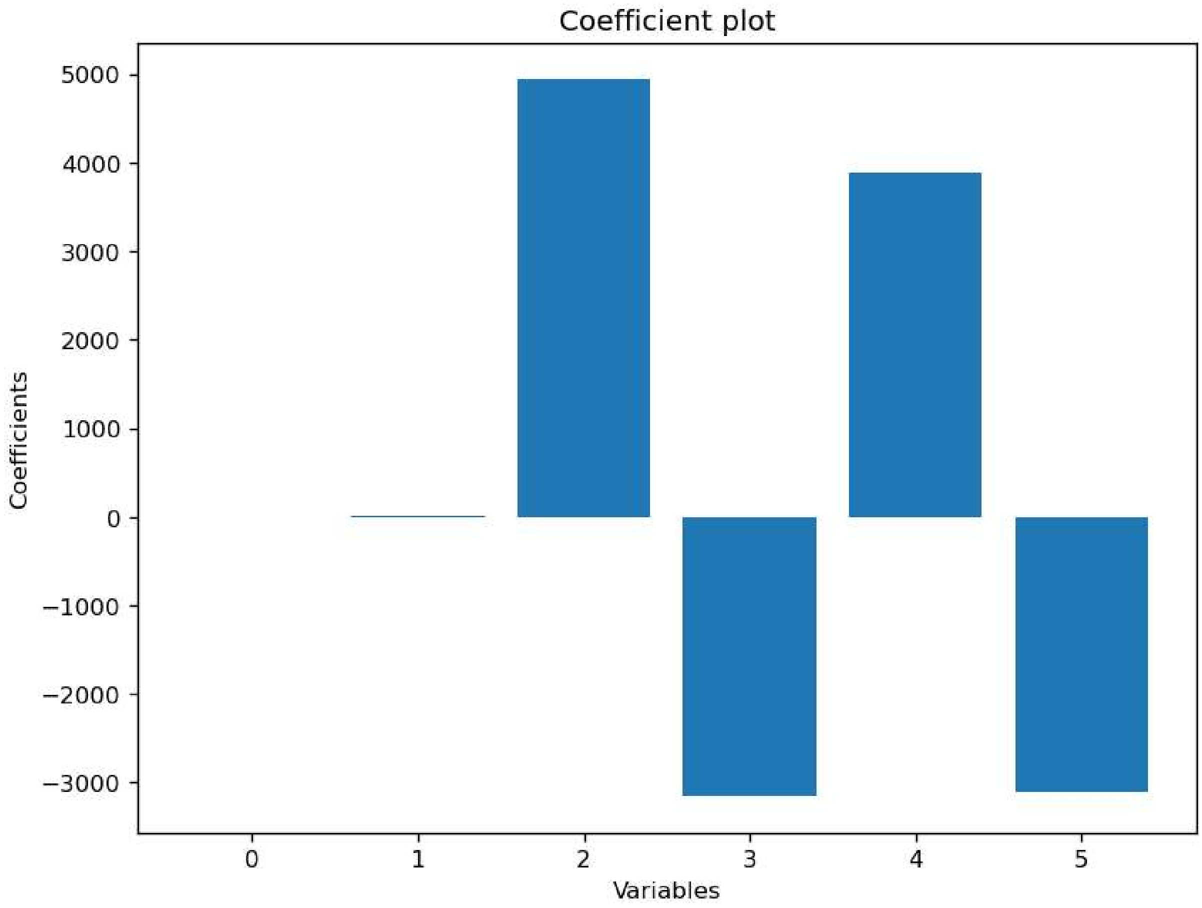
```
array([-1.67695182e-01,  6.53589860e+00,  4.93890845e+03, -3.16066179e+03,
        3.88314099e+03, -3.10767702e+03])
```

In [239]:

```
plt.figure(figsize=(8, 6), dpi=120, facecolor='w', edgecolor='b')
x = range(len(train_x.columns))
y = lr.coef_
plt.bar( x, y )
plt.xlabel( "Variables")
plt.ylabel('Coefficients')
plt.title('Coefficient plot')
```

Out[239]:

```
Text(0.5, 1.0, 'Coefficient plot')
```



The coefficients have been scaled. Some of the coefficient are insignificant so we can remove them.

In [224]:

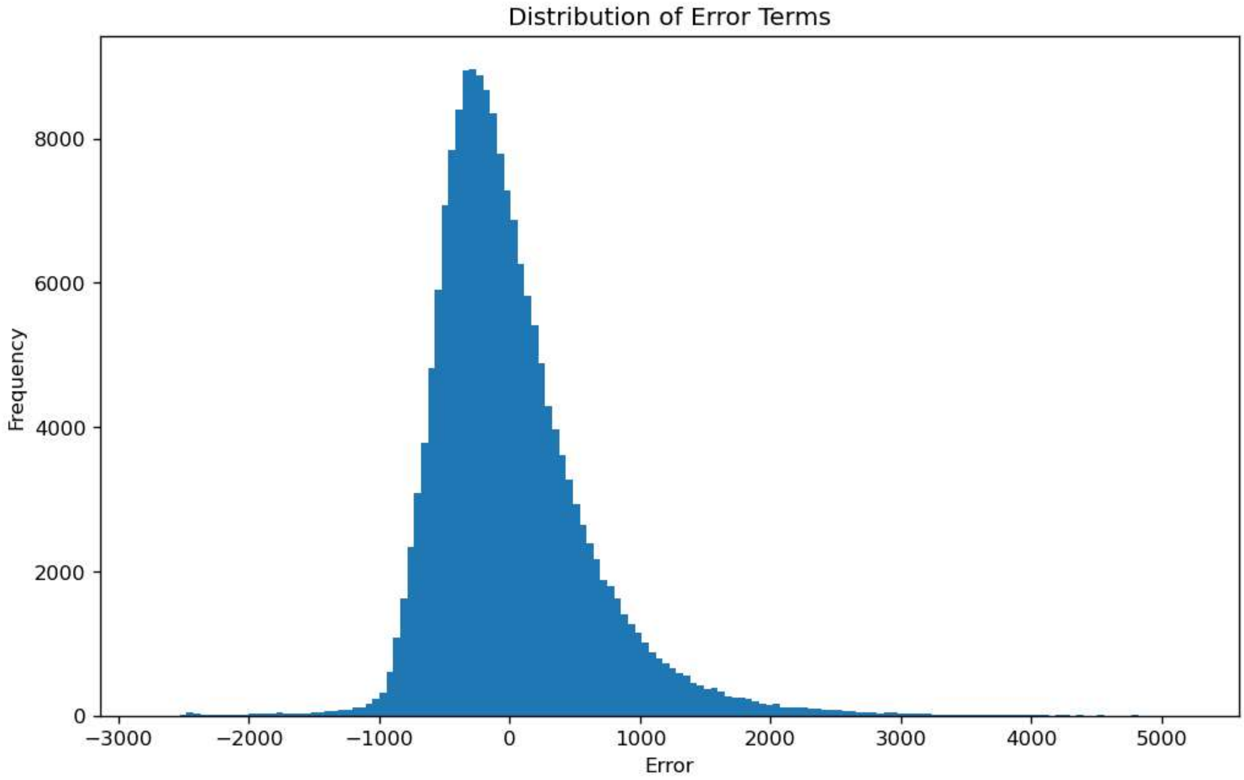
```
# Arranging and calculating the Residuals
residuals = pd.DataFrame({
    'fitted values' : test_y,
    'predicted values' : test_predict,
})

residuals['residuals'] = residuals['fitted values'] - residuals['predicted values']
residuals.head()
```

Out[224]:

	fitted values	predicted values	residuals
126475	380	7e+02	-3.2e+02
534206	523	7.2e+02	-1.9e+02
337897	671	6.6e+02	10
550805	3317	1.3e+03	2e+03
515205	1499	6.3e+02	8.7e+02

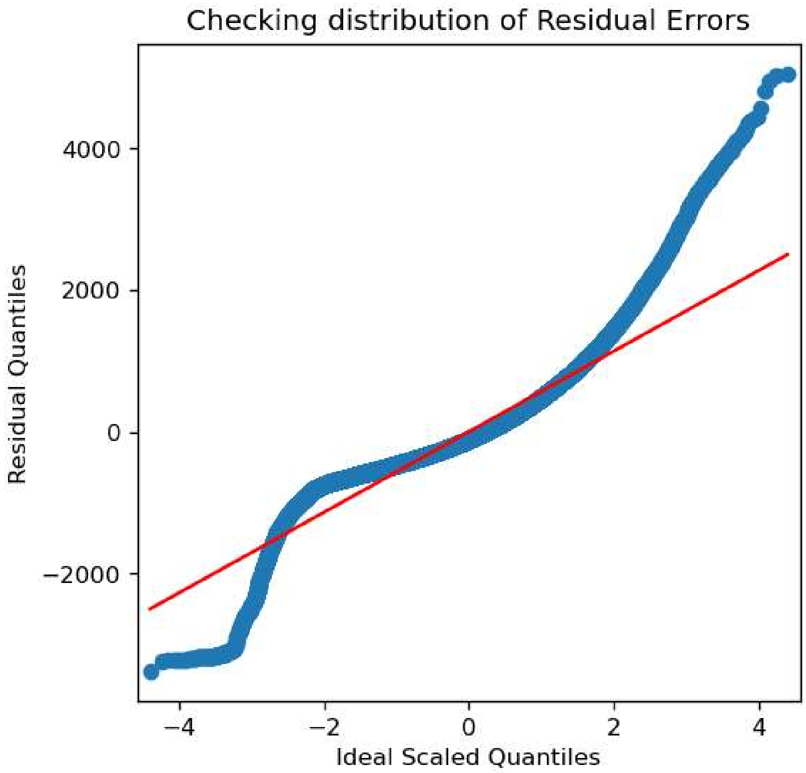
In [225]:

```
# Histogram for distribution
plt.figure(figsize=(10, 6), dpi=120, facecolor='w', edgecolor='b')
plt.hist(residuals.residuals, bins = 150)
plt.xlabel('Error')
plt.ylabel('Frequency')
plt.title('Distribution of Error Terms')
plt.show()
```



In [210]:

```
# importing the QQ-plot from the from the statsmodels
from statsmodels.graphics.gofplots import qqplot

## Plotting the QQ plot
fig, ax = plt.subplots(figsize=(5,5) , dpi = 120)
qqplot(residuals.residuals, line = 's' , ax = ax)
plt.ylabel('Residual Quantiles')
plt.xlabel('Ideal Scaled Quantiles')
plt.title('Checking distribution of Residual Errors')
plt.show()
```



Ridge regression model

In [240]:

```
# Importing ridge from sklearn's linear_model module
from sklearn.linear_model import Ridge

ridgeR = Ridge(alpha = 5)
ridgeR.fit(train_x,train_y)
y_pred = ridgeR.predict(test_x)

mean_squared_error_ridge = np.mean((y_pred-test_y)**2)
print("Mean squared error on test :", mean_squared_error_ridge)

ridge_coefficient = pd.DataFrame()
ridge_coefficient["Columns"] = train_x.columns
ridge_coefficient["Coefficient_Estimate"]= pd.Series(ridgeR.coef_)
print(ridge_coefficient)
```

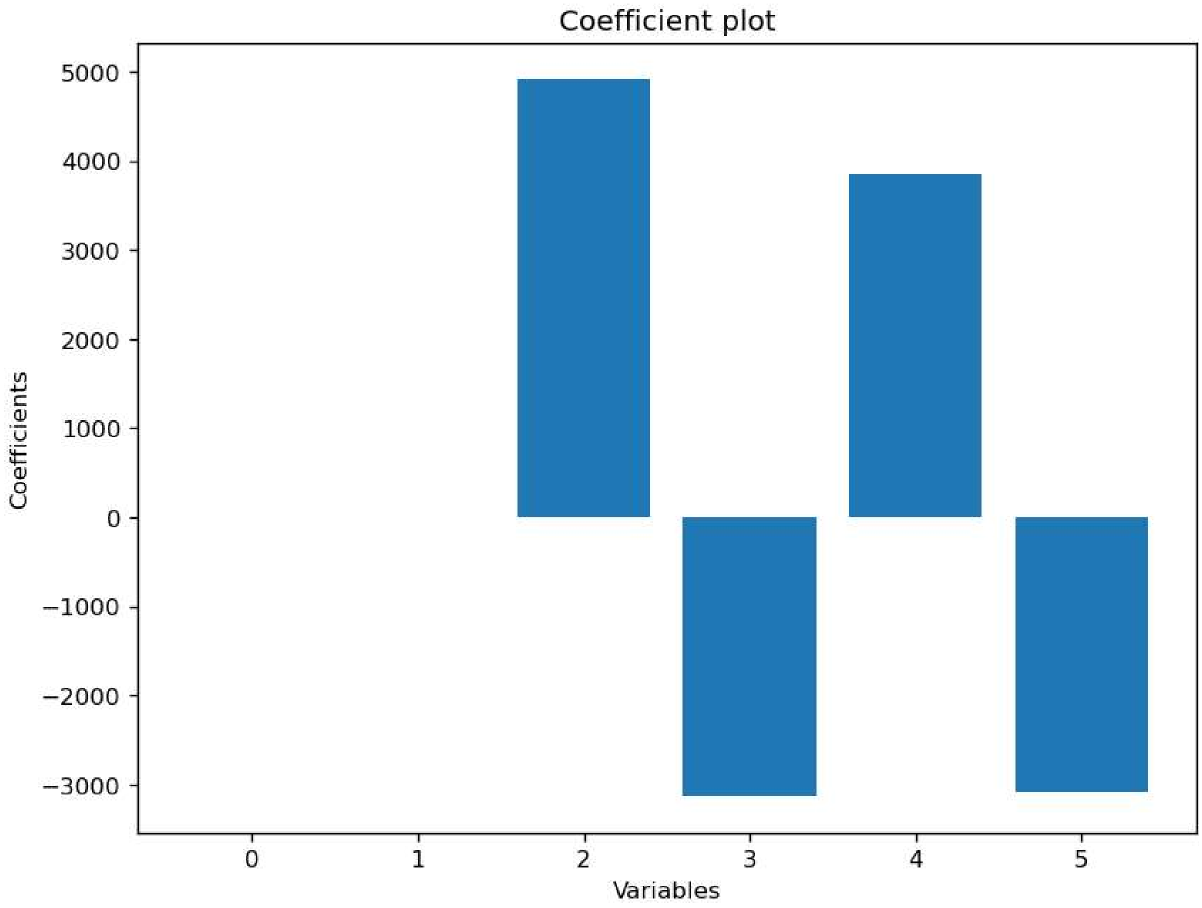
```
Mean squared error on test : 322937.74847921863
             Columns  Coefficient_Estimate
0          vendor_id                 -0.14
1    passenger_count                   6.5
2   pickup_longitude               4.9e+03
3    pickup_latitude              -3.1e+03
4  dropoff_longitude               3.9e+03
5   dropoff_latitude              -3.1e+03
```

In [241]:

```
plt.figure(figsize=(8, 6), dpi=120, facecolor='w', edgecolor='b')
x = range(len(train_x.columns))
y = ridgeR.coef_
plt.bar( x, y )
plt.xlabel( "Variables")
plt.ylabel('Coefficients')
plt.title('Coefficient plot')
```

Out[241]:

```
Text(0.5, 1.0, 'Coefficient plot')
```



This is bar plot after Ridge regression model.

Lasso Regression model

In [242]:

```
# Importing Lasso from sklearn's linear_model module
from sklearn.linear_model import Lasso

lasso = Lasso(alpha = 1)
lasso.fit(train_x,train_y)
y_pred1 = lasso.predict(test_x)

mean_squared_error = np.mean((y_pred1-test_y)**2)
print("Mean squared error on test :", mean_squared_error)

lasso_coefficient = pd.DataFrame()
lasso_coefficient["Columns"] = train_x.columns
lasso_coefficient["Coefficient_Estimate"]= pd.Series(lasso.coef_)
print(lasso_coefficient)
```

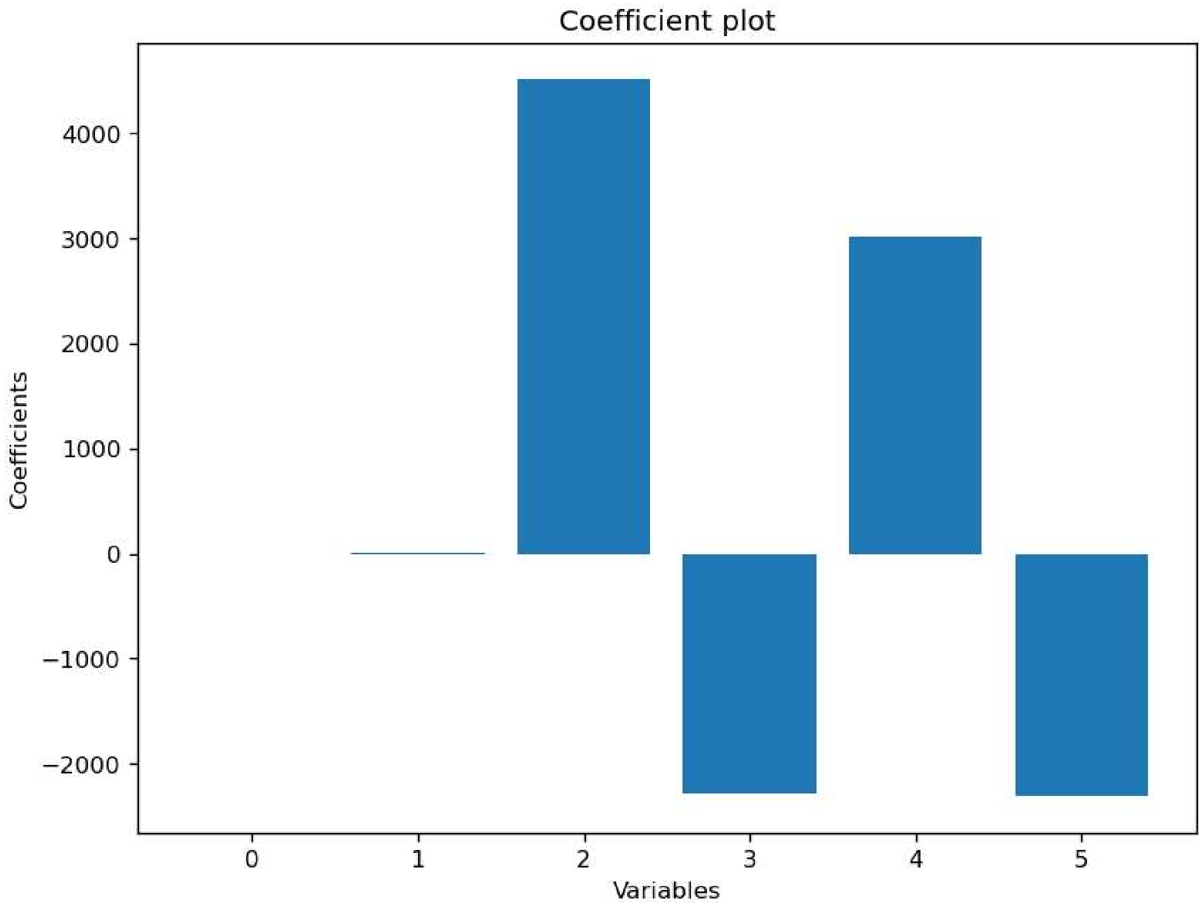
```
Mean squared error on test : 326003.64275173476
             Columns  Coefficient_Estimate
0          vendor_id                     0
1    passenger_count                   6.1
2   pickup_longitude               4.5e+03
3    pickup_latitude              -2.3e+03
4  dropoff_longitude                 3e+03
5   dropoff_latitude              -2.3e+03
```

In [243]:

```
plt.figure(figsize=(8, 6), dpi=120, facecolor='w', edgecolor='b')
x = range(len(train_x.columns))
y = lasso.coef_
plt.bar( x, y )
plt.xlabel( "Variables")
plt.ylabel('Coefficients')
plt.title('Coefficient plot')
```

Out[243]:

```
Text(0.5, 1.0, 'Coefficient plot')
```



This is bar plot after Lasso regression model.

linear regression after removing insignificant Coefficents

In [244]:

```
#seperating independent and dependent variables
x = df.drop(['trip_duration'], axis=1)
y = df['trip_duration']
x.shape, y.shape
```

Out[244]:

```
((724984, 6), (724984,))
```

In [212]:

```
Coefficients = pd.DataFrame({
    'Variable'    : x.columns,
    'coefficient' : lr.coef_
})
Coefficients.head()
```

Out[212]:

	Variable	coefficient
0	vendor_id	-0.17
1	passenger_count	6.5
2	pickup_longitude	4.9e+03
3	pickup_latitude	-3.2e+03
4	dropoff_longitude	3.9e+03

In [213]:

```
sig_var = Coefficients[Coefficients.coefficient > 0.5]
```

In [214]:

```
subset = df[sig_var['Variable'].values]
subset.head()
```

Out[214]:

	passenger_count	pickup_longitude	dropoff_longitude
0	1	-74	-74
1	2	-74	-74
2	2	-74	-74
3	6	-74	-74
4	1	-74	-74

In [215]:

```
lr_coefficient = pd.DataFrame()
lr_coefficient["Columns"] = train_x.columns
lr_coefficient["Coefficient_Estimate"]= pd.Series(lr.coef_)
print(lr_coefficient)
```

```
             Columns  Coefficient_Estimate
0          vendor_id                 -0.17
1    passenger_count                   6.5
2   pickup_longitude               4.9e+03
3    pickup_latitude              -3.2e+03
4  dropoff_longitude               3.9e+03
5   dropoff_latitude              -3.1e+03
```

In [216]:

```
# Importing the train test split function
from sklearn.model_selection import train_test_split
train_x,test_x,train_y,test_y = train_test_split(subset, y , random_state = 52)
```

In [217]:

```
#importing Linear Regression and metric mean square error
from sklearn.linear_model import LinearRegression as LR
from sklearn.metrics import mean_absolute_error as mae
```

In [218]:

```
# Creating instance of Linear Regresssion with Normalised Data
lr = LR(normalize = True)

# Fitting the model
lr.fit(train_x, train_y)

# Predicting over the Train Set and calculating error
train_predict = lr.predict(train_x)
k = mae(train_predict, train_y)
print('Training Mean Absolute Error', k )

# Predicting over the Test Set and calculating error
test_predict = lr.predict(test_x)
k = mae(test_predict, test_y)
print('Test Mean Absolute Error    ', k )
```

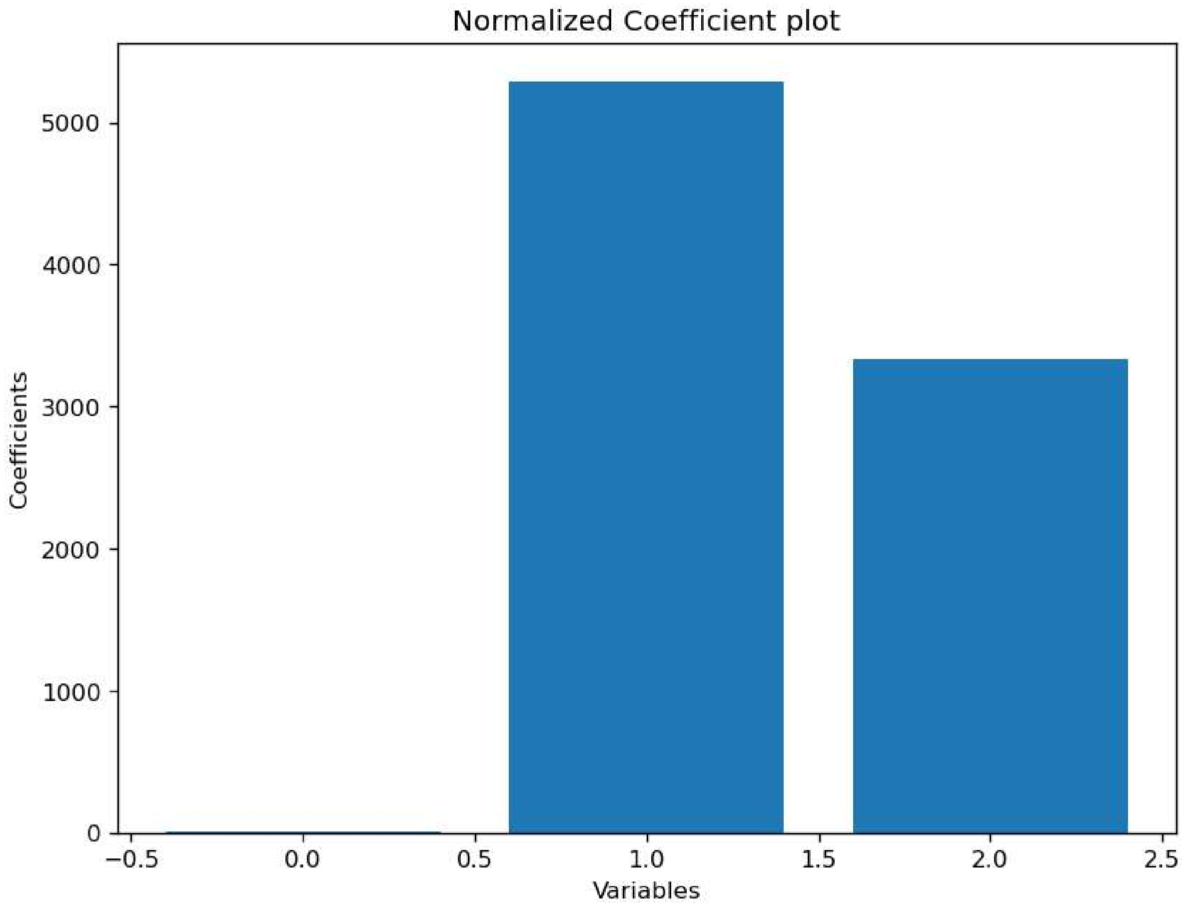
```
Training Mean Absolute Error 430.5039621614265
Test Mean Absolute Error     431.52785110658874
```

In [219]:

```
plt.figure(figsize=(8, 6), dpi=120, facecolor='w', edgecolor='b')
x = range(len(train_x.columns))
y = lr.coef_
plt.bar( x, y )
plt.xlabel( "Variables")
plt.ylabel('Coefficients')
plt.title('Normalized Coefficient plot')
```

Out[219]:

```
Text(0.5, 1.0, 'Normalized Coefficient plot')
```



This is the plot after removing insignificant coefficients and scaling the coefficients.

Type *Markdown* and LaTeX: α^2

In [ ]: