In [1]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

In [2]:
```python
#loading csv file as a data frame using pandas
df = pd.read_csv('cars.csv')
```

In [3]:
```python
#exploring data for any null or invalid values
df.head()
```

Out[3]:

	passedemissions	mpg	displacement	horsepower	cylinders	weight	acceleration	modelyear	carname
0	False	18.0	307.0	130.0	8.0	1.7520	12.0	70.0	chevrolet chevelle malibu
1	False	15.0	350.0	165.0	8.0	1.8465	11.5	70.0	buick skylark 320
2	False	18.0	318.0	150.0	8.0	1.7180	11.0	70.0	plymouth satellite
3	False	16.0	304.0	150.0	8.0	1.7165	12.0	70.0	amc rebel sst
4	False	17.0	302.0	140.0	8.0	1.7245	10.5	70.0	ford torino

In [4]:
```python
df.describe()
```

Out[4]:

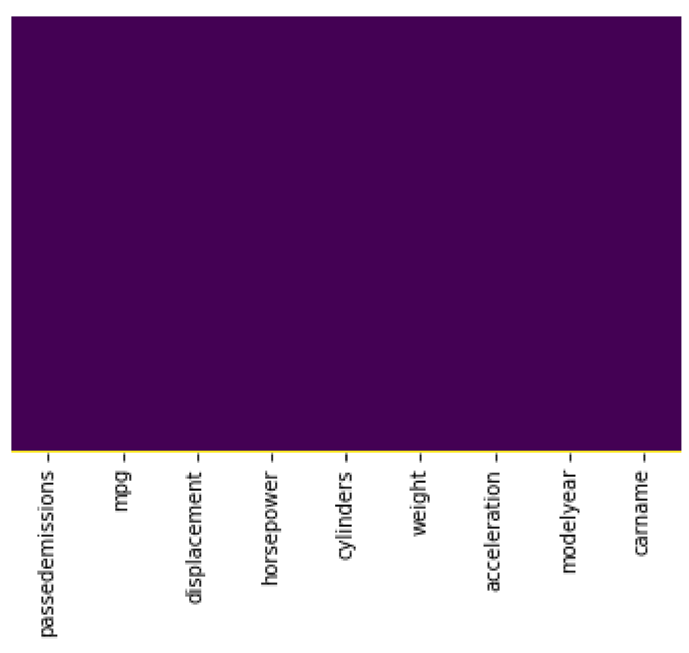
	mpg	displacement	horsepower	cylinders	weight	acceleration	modelyear
count	392.000000	392.000000	392.000000	392.000000	392.000000	392.000000	392.000000
mean	23.445918	194.411990	104.469388	5.471939	1.488792	15.541327	75.979592
std	7.805007	104.644004	38.491160	1.705783	0.424701	2.758864	3.683737
min	9.000000	68.000000	46.000000	3.000000	0.806500	8.000000	70.000000
25%	17.000000	105.000000	75.000000	4.000000	1.112625	13.775000	73.000000
50%	22.750000	151.000000	93.500000	4.000000	1.401750	15.500000	76.000000
75%	29.000000	275.750000	126.000000	8.000000	1.807375	17.025000	79.000000
max	46.600000	455.000000	230.000000	8.000000	2.570000	24.800000	82.000000

In [5]:
```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 393 entries, 0 to 392
Data columns (total 9 columns):
passedemissions    392 non-null object
mpg                392 non-null float64
displacement       392 non-null float64
horsepower         392 non-null float64
cylinders          392 non-null float64
weight             392 non-null float64
acceleration       392 non-null float64
modelyear          392 non-null float64
carname            392 non-null object
dtypes: float64(7), object(2)
memory usage: 27.7+ KB
```

In [17]:
```python
sns.heatmap(df.isnull(),yticklabels=False,cbar=False,cmap='viridis')
```

Out[17]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1b0e715f4e0>
```



In [18]:
```python
df.tail()
```

Out[18]:

	passedemissions	mpg	displacement	horsepower	cylinders	weight	acceleration	modelyear	carname
388	True	44.0	97.0	52.0	4.0	1.0650	24.6	82.0	vw pickup
389	True	32.0	135.0	84.0	4.0	1.1475	11.6	82.0	dodge rampage
390	True	28.0	120.0	79.0	4.0	1.3125	18.6	82.0	ford ranger
391	True	31.0	119.0	82.0	4.0	1.3600	19.4	82.0	chevy s-10
392	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

In [ ]:

In [ ]:

In [ ]:

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In [56]:
```python
#dropping last row which contains null values
df.dropna(inplace=True)
```

In [57]:
```python
#converting the boolean value of passedemissions into integers
passed_emissions=pd.get_dummies(df['passedemissions'],drop_first=True)
```

In [58]:
```python
df.tail()
```

Out[58]:

	passedemissions	mpg	displacement	horsepower	cylinders	weight	acceleration	modelyear	carname
387	True	27.0	140.0	86.0	4.0	1.3950	15.6	82.0	ford mustang gl
388	True	44.0	97.0	52.0	4.0	1.0650	24.6	82.0	vw pickup
389	True	32.0	135.0	84.0	4.0	1.1475	11.6	82.0	dodge rampage
390	True	28.0	120.0	79.0	4.0	1.3125	18.6	82.0	ford ranger
391	True	31.0	119.0	82.0	4.0	1.3600	19.4	82.0	chevy s-10

In [59]:
```python
#adding new column of integered passed emission variable
df = pd.concat([df,passed_emissions],axis=1)
```

In [60]:
```python
df.head()
```

Out[60]:

	passedemissions	mpg	displacement	horsepower	cylinders	weight	acceleration	modelyear	carname	True
0	False	18.0	307.0	130.0	8.0	1.7520	12.0	70.0	chevrolet chevelle malibu	0
1	False	15.0	350.0	165.0	8.0	1.8465	11.5	70.0	buick skylark 320	0
2	False	18.0	318.0	150.0	8.0	1.7180	11.0	70.0	plymouth satellite	0
3	False	16.0	304.0	150.0	8.0	1.7165	12.0	70.0	amc rebel sst	0
4	False	17.0	302.0	140.0	8.0	1.7245	10.5	70.0	ford torino	0

In [61]:
```python
df.columns
```

Out[61]:
```
Index(['passedemissions',             'mpg',    'displacement',
            'horsepower',       'cylinders',          'weight',
          'acceleration',       'modelyear',         'carname',
                    True],
      dtype='object')
```

In [62]:
```python
X=df[['displacement','horsepower','cylinders','weight','acceleration','modelyear',True]]
```

In [63]:
```python
#target variable
y=df['mpg']
```

In [65]:
```python
from sklearn.model_selection import train_test_split
```

In [66]:
```python
#splitting the data into two: test and training data in ratio of 30 and 70 percent resp.
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=101)
```

In [67]:
```python
from sklearn.linear_model import LinearRegression
```

In [68]:
```python
lm = LinearRegression()
```

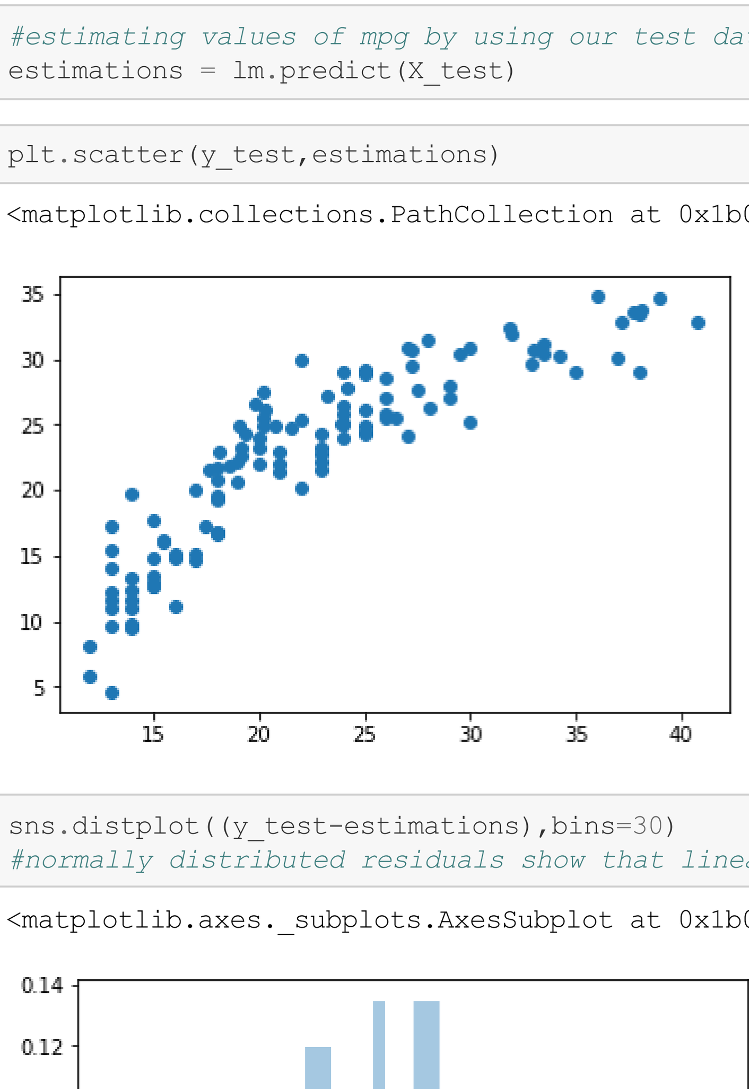
In [69]:
```python
#fitting the model using our training data
lm.fit(X_train,y_train)
```

Out[69]:
```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None,
         normalize=False)
```

In [70]:
```python
#estimating values of mpg by using our test data
estimations = lm.predict(X_test)
```

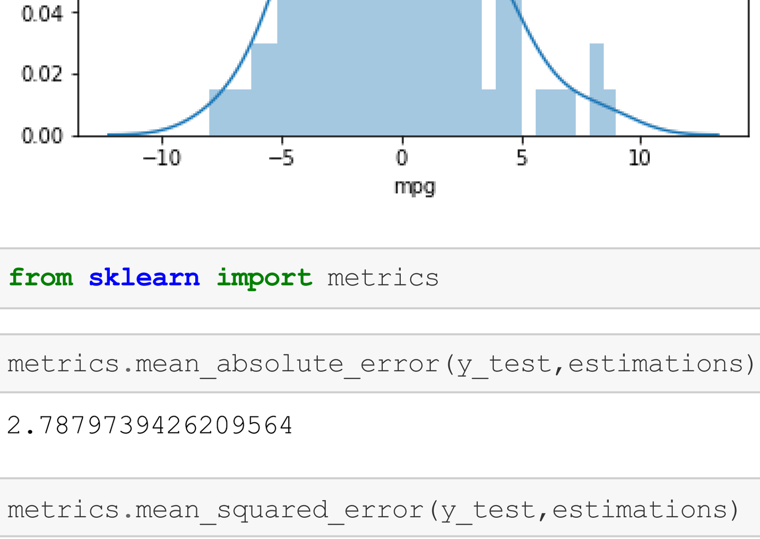
In [71]:
```python
plt.scatter(y_test,estimations)
```

Out[71]:
```
<matplotlib.collections.PathCollection at 0x1b0ea46eb00>
```



In [74]:
```python
sns.distplot((y_test-estimations),bins=30)
#normally distributed residuals show that linear regression was a good option
```

Out[74]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1b0ea506a20>
```



In [75]:
```python
from sklearn import metrics
```

In [76]:
```python
metrics.mean_absolute_error(y_test,estimations)
```

Out[76]:
```
2.7879739426209564
```

In [77]:
```python
metrics.mean_squared_error(y_test,estimations)
```

Out[77]:
```
11.82403930231483
```

In [78]:
```python
np.sqrt(metrics.mean_squared_error(y_test,estimations))
```

Out[78]:
```
3.438610082913564
```

In [ ]: