In [0]:
```
import warnings
warnings.filterwarnings("ignore")
from sklearn.datasets import load_boston
from random import seed
from random import randrange
from csv import reader
from math import sqrt
from sklearn import preprocessing
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from prettytable import PrettyTable
from sklearn.linear_model import SGDRegressor
from sklearn import preprocessing
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import train_test_split
```

In [0]:
```
boston = load_boston()
X = boston.data
Y = boston.target
```

In [92]:
```
boston.feature_names
```

Out[92]:
```
array(['CRIM', 'ZN', 'INDUS', 'CHAS', 'NOX', 'RM', 'AGE', 'DIS', 'RAD',
       'TAX', 'PTRATIO', 'B', 'LSTAT'], dtype='<U7')
```

In [0]:
```
X_train,X_test,y_train,y_test = train_test_split(X,Y,test_size=.33,rand
om_state=0)
```

In [0]:
```
scaler = preprocessing.StandardScaler()
X_train = scaler.fit_transform(np.array(X_train))
X_test = scaler.transform(np.array(X_test))
```

In [95]:
```
print("X_train shape: ",X_train.shape)
```

```
print("y_train shape: ",y_train.shape)
print("X_test shape: ",X_test.shape)
print("y_test shape: ",y_test.shape)
```

```
X_train shape:  (339, 13)
y_train shape:  (339,)
X_test shape:  (167, 13)
y_test shape:  (167,)
```

In [96]:

```
train_df = pd.DataFrame(X_train, columns = boston.feature_names)
train_df["price"] = y_train
test_df = pd.DataFrame(X_test, columns = boston.feature_names)
test_df["price"] = y_test
train_df.head(3)
```

Out[96]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	
0	-0.400693	0.548889	-0.899201	-0.269787	-1.133607	0.435142	0.051507	0.810611	-(
1	0.129731	-0.500121	1.003242	-0.269787	1.827802	0.121731	0.678800	-0.590760	1
2	1.169737	-0.500121	1.003242	-0.269787	1.164929	-0.602944	0.917599	-0.948626	1

In [0]:

```
# SGD from scrach
#initialize the value of w, b and r
def sgd_opt(X_train,y_train):

  r = 0.1
  w = np.zeros(13)
  b = 0
  k = 50
  for j in range(1,1000):
    e = 0
    W_temp = np.zeros(13)
    b_temp = 0

    #sample data into k size batch randomly
    data = train_df.sample(k)
```

```
    x = np.array(data.drop('price', axis = 1))
    y = np.array(data['price'])

    for i in range(k):

      loss = y[i]-np.dot(w,x[i])-b

      W_temp = (-2) * (x[i]*(loss))
      b_temp = (-2) * loss
      w -= (r*(W_temp/k))
      b -= (r*(b_temp/k))

      e += loss**2


    if j%500 == 0:
      print("Epoch: {}, loss: {} ".format(j,e/k))

  return w,b
```

In [182]:
```
w,b = sgd_opt(X_train,y_train)
print(w)
print(b)
```

```
Epoch: 500, loss: 14.722672063412418
[-1.14332942  1.30478645 -0.01646313  0.41657651 -1.66045481  2.4384131
4
 -0.49263915 -3.46884248  2.34821353 -1.81339463 -2.21063135  0.7083574
5
 -4.08020371]
22.894811876132664
```

In [0]:
```
#linear regression
def predict(X_test,w,b):
  X_test = np.array(X_test)
  y_pred = []

  for i in range(len(X_test)):
    y_pred.append(np.asscalar(np.dot(w,X_test[i])+b))
```

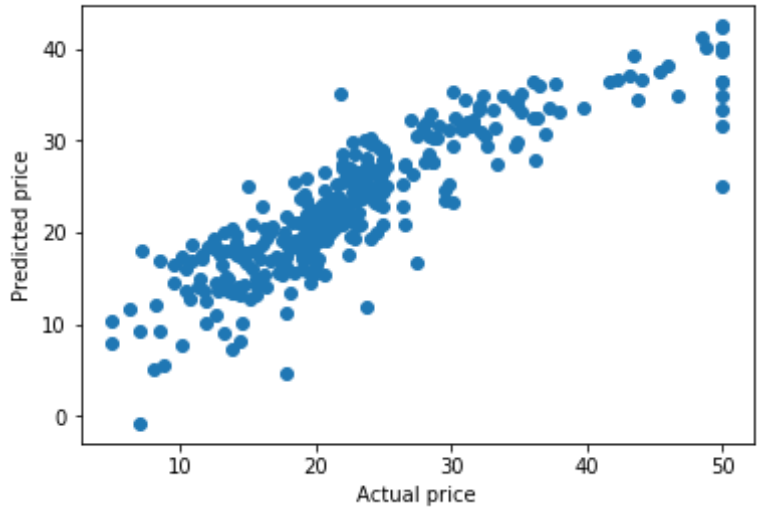
```
  return np.array(y_pred)

y_pred_tr = np.dot(train_df.drop('price',axis=1),w) + b
```

In [184]:
```
#MSE
print(mean_squared_error(y_train,y_pred_tr))
```

```
20.23029009037871
```

In [165]:
```
plt.scatter(y_train,y_pred_tr)
plt.xlabel("Actual price")
plt.ylabel("Predicted price")
plt.show()
```



In [0]:
```
#calculate for test data
y_pred_te = predict(X_test,w.T,b)
```

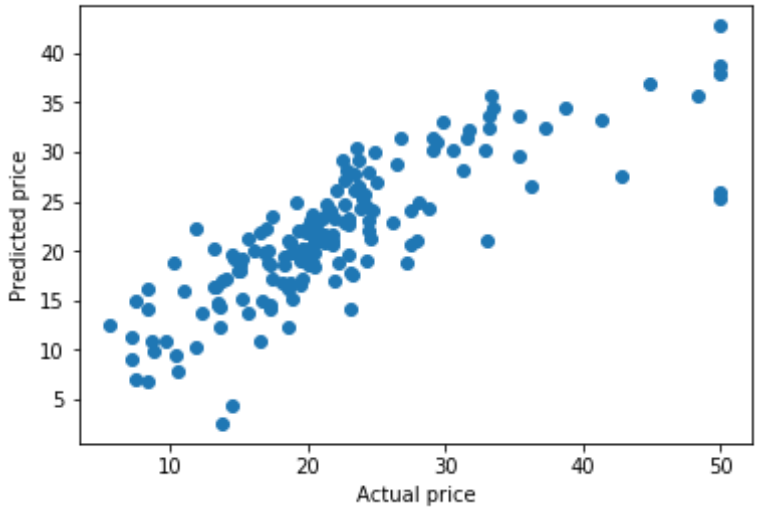
In [167]:
```
print(b)
```

```
22.873688453140463
```

In [168]:
```
#MSE for test data
print(mean_squared_error(y_test,y_pred_te))
```

```
26.82011750732191
```

In [169]:
```
plt.scatter(y_test,y_pred_te)
plt.xlabel("Actual price")
plt.ylabel("Predicted price")
plt.show()
```

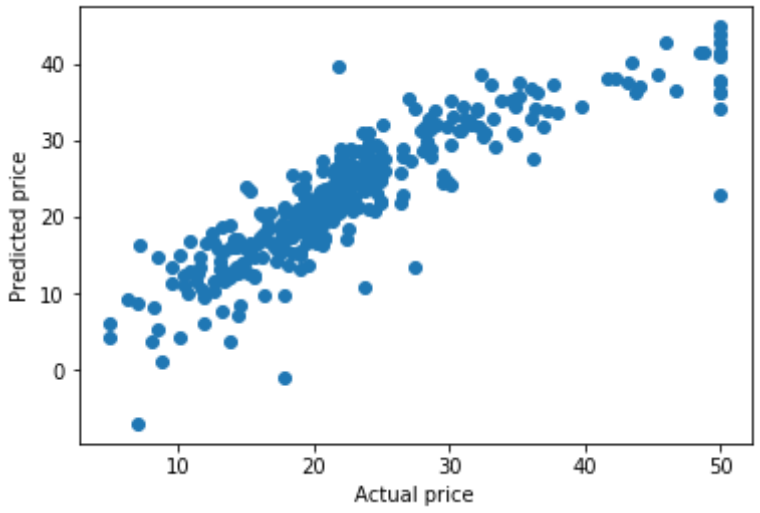


In [187]:
```
clf = SGDRegressor(learning_rate='constant',eta0 = 0.01,n_iter_no_chang
e=10000)
clf.fit(X_train, y_train)
y_pred_tr = clf.predict(X_train)
print(mean_squared_error(y_train,y_pred_tr))
```

```
20.793364926927733
```

In [0]:
```
W_sklearn = clf.coef_
b_sklearn = clf.intercept_[0]
```

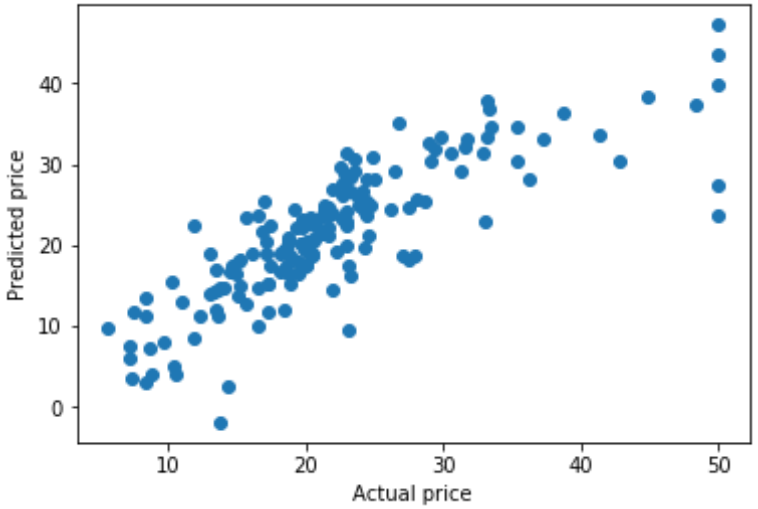
In [189]:
```
plt.scatter(y_train,y_pred_tr)
plt.xlabel("Actual price")
plt.ylabel("Predicted price")
plt.show()
```



In [190]:
```
y_pred_te = clf.predict(X_test)
print(mean_squared_error(y_test,y_pred_te))
```

```
27.55916018550341
```

In [191]:
```
plt.scatter(y_test,y_pred_te)
plt.xlabel("Actual price")
plt.ylabel("Predicted price")
plt.show()
```



In [192]:
```
#compare results of both SGD
w_df = pd.DataFrame(columns = ['W','W_sklearn'])
w_df['W']= w
w_df['W_sklearn'] = W_sklearn
w_df
```

Out[192]:

	W	W_sklearn
0	-1.143329	-0.983428
1	1.304786	0.808974
2	-0.016463	-0.170339
3	0.416577	1.270474
4	-1.660455	-1.721755
5	2.438413	2.722495
6	-0.492639	-0.445723
7	-3.468842	-3.119087

	W	W_sklearn
8	2.348214	1.563753
9	-1.813395	-1.140593
10	-2.210631	-2.314132
11	0.708357	0.762584
12	-4.080204	-4.025652

In [193]:
```
mse_df = pd.DataFrame([[20.23029009037871,
26.82011750732191,22.8736884531404 63],[20.793364926927733,
27.55916018550341,b_sklearn]],columns=['MSE on train','MSE on test','b'
],index=['my SGD','sklearn SGD'])
mse_df
```

Out[193]:

	MSE on train	MSE on test	b
my SGD	20.230290	26.820118	22.873688
sklearn SGD	20.793365	27.559160	22.733110

From above comparision My SGD and sklearn SGD performes similar.