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

from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
```

CRIM: Per capita crime rate by town
ZN: Proportion of residential land zoned for lots over 25,000 sq. ft
INDUS: Proportion of non-retail business acres per town
CHAS: Charles River dummy variable (= 1 if tract bounds river; 0 otherwise)
NOX: Nitric oxide concentration (parts per 10 million)
RM: Average number of rooms per dwelling
AGE: Proportion of owner-occupied units built prior to 1940
DIS: Weighted distances to five Boston employment centers
RAD: Index of accessibility to radial highways
TAX: Full-value property tax rate per $10,000
PTRATIO: Pupil-teacher ratio by town
B: $1000(Bk — 0.63)^2$, where Bk is the proportion of [people of African American descent] by town
LSTAT: Percentage of lower status of the population

In [2]:
```
# Importing Data
from sklearn.datasets import load_boston
boston_data = load_boston()
```

In [3]:
```
boston = pd.DataFrame(boston_data.data, columns=boston_data.feature_names)
boston.head()
```

Out[3]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTAT
0	0.00632	18.0	2.31	0.0	0.538	6.575	65.2	4.0900	1.0	296.0	15.3	396.90	4.98
1	0.02731	0.0	7.07	0.0	0.469	6.421	78.9	4.9671	2.0	242.0	17.8	396.90	9.14
2	0.02729	0.0	7.07	0.0	0.469	7.185	61.1	4.9671	2.0	242.0	17.8	392.83	4.03
3	0.03237	0.0	2.18	0.0	0.458	6.998	45.8	6.0622	3.0	222.0	18.7	394.63	2.94
4	0.06905	0.0	2.18	0.0	0.458	7.147	54.2	6.0622	3.0	222.0	18.7	396.90	5.33

In [4]:
```
#Now we'll add price column
boston['Price'] = boston_data.target
boston.head()
```

Out[4]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTAT
0	0.00632	18.0	2.31	0.0	0.538	6.575	65.2	4.0900	1.0	296.0	15.3	396.90	4.98
1	0.02731	0.0	7.07	0.0	0.469	6.421	78.9	4.9671	2.0	242.0	17.8	396.90	9.14
2	0.02729	0.0	7.07	0.0	0.469	7.185	61.1	4.9671	2.0	242.0	17.8	392.83	4.03
3	0.03237	0.0	2.18	0.0	0.458	6.998	45.8	6.0622	3.0	222.0	18.7	394.63	2.94
4	0.06905	0.0	2.18	0.0	0.458	7.147	54.2	6.0622	3.0	222.0	18.7	396.90	5.33

In [5]:
```
boston.describe()
```

Out[5]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	
count	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000	506.00
mean	3.613524	11.363636	11.136779	0.069170	0.554695	6.284634	68.574901	3.79
std	8.601545	23.322453	6.860353	0.253994	0.115878	0.702617	28.148861	2.10
min	0.006320	0.000000	0.460000	0.000000	0.385000	3.561000	2.900000	1.12
25%	0.082045	0.000000	5.190000	0.000000	0.449000	5.885500	45.025000	2.10
50%	0.256510	0.000000	9.690000	0.000000	0.538000	6.208500	77.500000	3.20
75%	3.677083	12.500000	18.100000	0.000000	0.624000	6.623500	94.075000	5.18
max	88.976200	100.000000	27.740000	1.000000	0.871000	8.780000	100.000000	12.12

In [6]:
```
boston.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 506 entries, 0 to 505
Data columns (total 14 columns):
CRIM       506 non-null float64
ZN         506 non-null float64
INDUS      506 non-null float64
CHAS       506 non-null float64
NOX        506 non-null float64
RM         506 non-null float64
AGE        506 non-null float64
DIS        506 non-null float64
RAD        506 non-null float64
TAX        506 non-null float64
PTRATIO    506 non-null float64
B          506 non-null float64
LSTAT      506 non-null float64
Price      506 non-null float64
dtypes: float64(14)
memory usage: 55.5 KB
```

In [7]:
```
# splitting data to training and testing dataset

# Input Data
x = boston_data.data

# Output Data
y = boston_data.target

xtrain, xtest, ytrain, ytest = train_test_split(x, y, test_size =0.2,
                                                    random_state = 0)

print("xtrain shape : ", xtrain.shape)
print("xtest shape  : ", xtest.shape)
print("ytrain shape : ", ytrain.shape)
print("ytest shape  : ", ytest.shape)
```

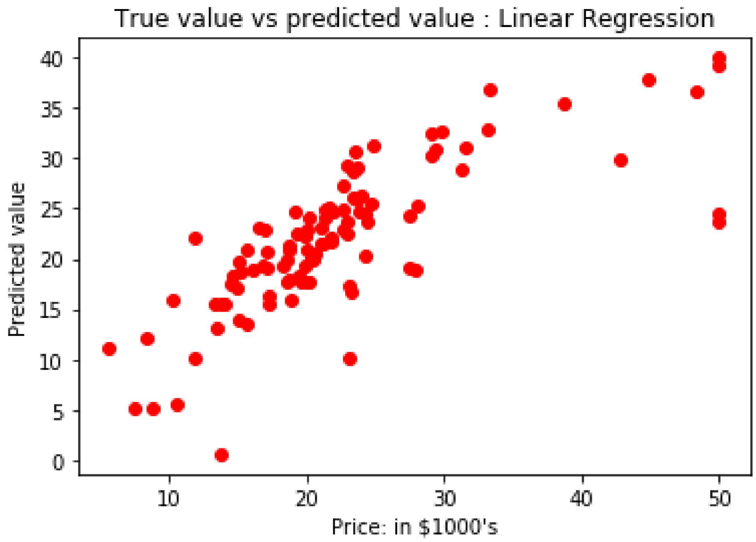
```
xtrain shape :  (404, 13)
xtest shape  :  (102, 13)
ytrain shape :  (404,)
ytest shape  :  (102,)
```

In [8]:
```
# Fitting Multi Linear regression model to training model
lr = LinearRegression()
lr.fit(xtrain, ytrain)

# predicting the test set results
y_pred = lr.predict(xtest)
```

In [9]:
```
# Results of Linear Regression.

from sklearn import metrics
from sklearn.metrics import r2_score
print('Mean Absolute Error : ', metrics.mean_absolute_error(ytest, y_pred))
print('Mean Square Error : ', metrics.mean_squared_error(ytest, y_pred))
print('RMSE', np.sqrt(metrics.mean_squared_error(ytest, y_pred)))
print('R squared error', r2_score(ytest, y_pred))
```

```
Mean Absolute Error :  3.8429092204444983
Mean Square Error :  33.44897999767656
RMSE 5.783509315085138
R squared error 0.5892223849182504
```

In [10]:
```
plt.scatter(ytest, y_pred, c = 'red')
plt.xlabel("Price: in $1000's")
plt.ylabel("Predicted value")
plt.title("True value vs predicted value : Linear Regression")
plt.show()
```



Now Ridge Regression

In [11]:
```
from sklearn.linear_model import Ridge
clf = Ridge(alpha=0.3)
clf.fit(xtrain, ytrain)
```

Out[11]:
```
Ridge(alpha=0.3, copy_X=True, fit_intercept=True, max_iter=None,
      normalize=False, random_state=None, solver='auto', tol=0.001)
```

In [12]:
```
#coefficient
clf.coef_
```

Out[12]:
```
array([-1.18257051e-01,  4.52965149e-02, -7.60092263e-03,  2.32506112e+00,
       -1.27414080e+01,  3.73464968e+00, -6.42498300e-03, -1.33872156e+00,
        2.34050275e-01, -1.12187382e-02, -1.01134861e+00,  8.30085958e-03,
       -4.95119514e-01])
```

In [13]:

```
# predicting the test set results
y_pred2 = clf.predict(xtest)

print('Mean Absolute Error : ', metrics.mean_absolute_error(ytest, y_pred2))
print('Mean Square Error : ', metrics.mean_squared_error(ytest, y_pred2))
print('RMSE', np.sqrt(metrics.mean_squared_error(ytest, y_pred2)))
print('R squared error', r2_score(ytest, y_pred2))
```

```
Mean Absolute Error :  3.833302523389471
Mean Square Error :  33.736190768885855
RMSE 5.808286388332264
R squared error 0.5856952293627944
```

In [14]:

```
plt.scatter(ytest, y_pred2, c = 'red')
plt.xlabel("Price: in $1000's")
plt.ylabel("Predicted value")
plt.title("True value vs predicted value : Ridge Regression")
plt.show()
```