Conditions of linear regression

In [1]:
```
%matplotlib inline
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
from scipy import stats
import seaborn as sns
import statsmodels.api as sm
from sklearn import linear_model
```

```
C:\Users\Minerva\Anaconda2\lib\site-packages\statsmodels\compat\pandas.py:56: FutureWarn
ing: The pandas.core.datetools module is deprecated and will be removed in a future vers
ion. Please use the pandas.tseries module instead.
  from pandas.core import datetools
```

In [2]:
```
# Load the data into a pandas dataframe
iris = sns.load_dataset("iris")
iris.head()
```

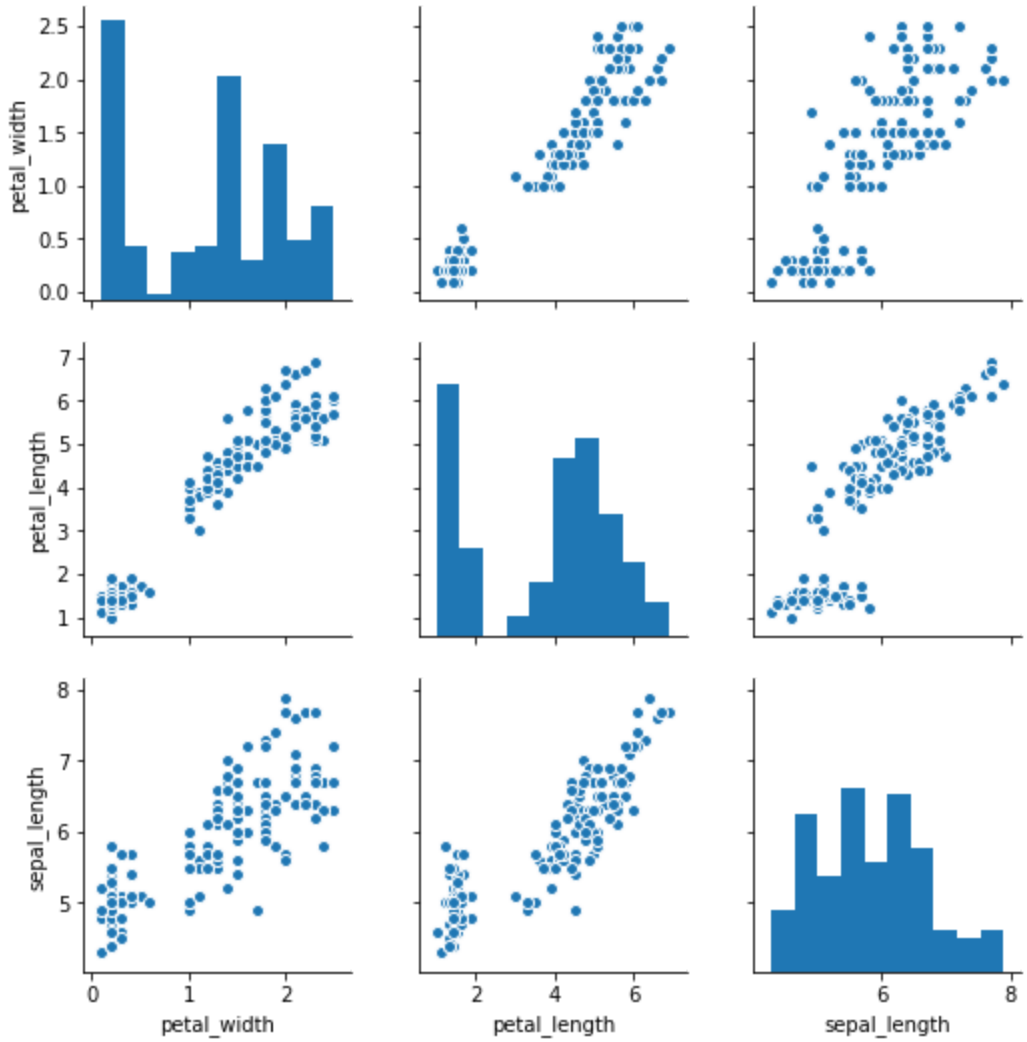
Out[2]:

	sepal_length	sepal_width	petal_length	petal_width	species
0	5.1	3.5	1.4	0.2	setosa
1	4.9	3.0	1.4	0.2	setosa
2	4.7	3.2	1.3	0.2	setosa
3	4.6	3.1	1.5	0.2	setosa
4	5.0	3.6	1.4	0.2	setosa

In [3]:
```
# Linear relationship between Y and Xs
```

In [4]:
```
sns.pairplot(iris[['petal_width', 'petal_length', 'sepal_length']].dropna(how = 'any', a
```

Out[4]:
```
<seaborn.axisgrid.PairGrid at 0x4121d68>
```



In [5]:

```
#Multiple Linear regression
#
X = iris[["petal_length","sepal_length"]]
X = sm.add_constant(X) # another way to add a constant row for an intercept
y = iris["petal_width"]

model = sm.OLS(y, X)
results = model.fit()
print(results.summary())
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results = model.fit()
# Statsmodels gives R-like statistical output
print(results.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:            petal_width   R-squared:                       0.929
Model:                            OLS   Adj. R-squared:                  0.928
Method:                 Least Squares   F-statistic:                     962.1
Date:                Sat, 02 Sep 2017   Prob (F-statistic):           3.60e-85
Time:                        01:59:02   Log-Likelihood:                 26.792
No. Observations:                 150   AIC:                            -47.58
Df Residuals:                     147   BIC:                            -38.55
Df Model:                           2
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          -0.0090      0.182     -0.049      0.961      -0.369       0.351
petal_length    0.4494      0.019     23.205      0.000       0.411       0.488
```

```
sepal_length    -0.0822      0.041     -1.992      0.048      -0.164      -0.001
==============================================================================
Omnibus:                        6.657   Durbin-Watson:                   1.414
Prob(Omnibus):                  0.036   Jarque-Bera (JB):                6.663
Skew:                           0.386   Prob(JB):                       0.0357
Kurtosis:                       3.685   Cond. No.                         80.7
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specifi
ed.
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==============================================================================

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```

In [ ]:

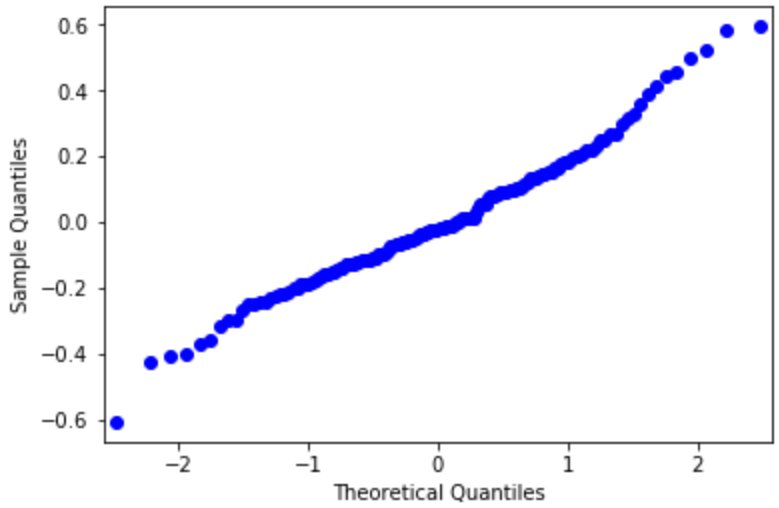
```
#JB test: test for normal distribution of residuals
## H0: The null hypothesis for the test is that the data are normally distributed (in th

# Unfortunately, with small samples the Jarque-Bera test is prone rejecting the null hyp
#that the distribution is normal—when it is in fact true
```

In [6]:

```
res = results.resid
```

In [7]:

```
sm.qqplot(res)
plt.show()
```



In [ ]:
```
#Durbin-watson: used for measuring autocorrelation
#pproximately equal to 2(1-r), where r is the sample autocorrelation

#ranges from zero to four, and a value around two suggests that there is no autocorrelat
#Values greater than two suggest negative correlation, and values less that one suggest
```

Multicollinearity

In [8]:
```
#condition no.: used for measuring multi-collinearity
# cond no>30 means multi-collinearity
#influences the stability & reliability of coefficents
```

In [9]:
```
corr=X.corr() #correlation bw predictors
print(corr)
```

```
              const  petal_length  sepal_length
const           NaN           NaN           NaN
petal_length    NaN      1.000000      0.871754
sepal_length    NaN      0.871754      1.000000
```

heteroscedasticity

test whether the variance of the errors from a regression is dependent on the values of the independent variables

there should ne relation or pattern between residuals and fitted values, i.e. we want homoscedasticity

breusch-pagan test

h0: null hypothesis of the Breusch-Pagan test is homoscedasticity (= variance does not depend on auxiliary regressors)

In [10]:
```
import statsmodels.stats.api as sms
from statsmodels.compat import lzip
```

In [11]:
```
name = ['Lagrange multiplier statistic', 'p-value',
        'f-value', 'f p-value']
test = sms.het_breushpagan(results.resid, results.model.exog)
lzip(name, test)
```

```
C:\Users\Minerva\Anaconda2\lib\site-packages\ipykernel_launcher.py:3: DeprecationWarnin
g: `het_breushpagan` is deprecated, use `het_breuschpagan` instead!
Use het_breuschpagan, het_breushpagan will be removed in 0.9
(Note: misspelling missing 'c')
  This is separate from the ipykernel package so we can avoid doing imports until
```

Out[11]:
```
[('Lagrange multiplier statistic', 23.534479417490889),
 ('p-value', 7.7544808402163839e-06),
 ('f-value', 13.677911807250478),
 ('f p-value', 3.5665183433605118e-06)]
```

In [ ]:
```
#reject the null hypothesis that the variance of the residuals is constant and infer tha
```

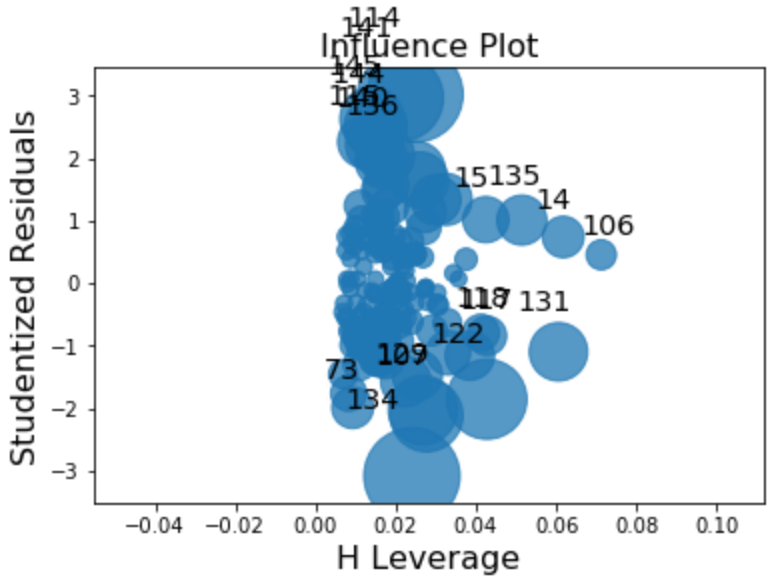
Influence Test

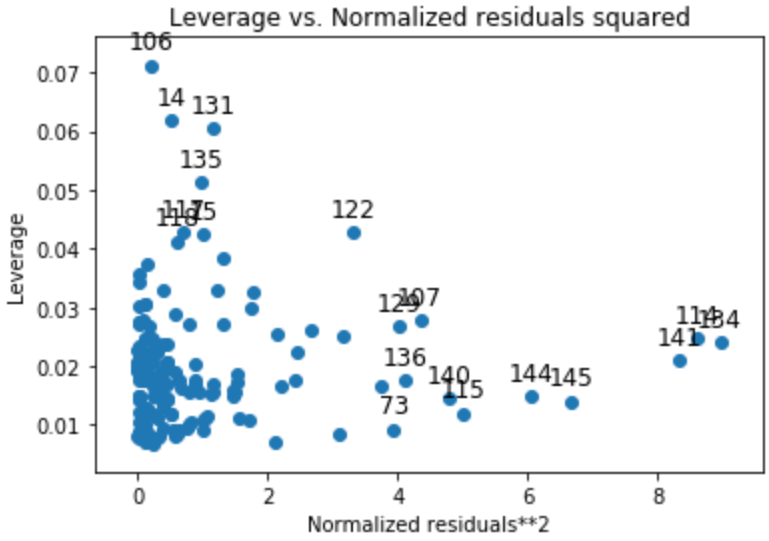
plot helps us to find influential cases (i.e., subjects) if any. Not all outliers are influential in linear regression analysis

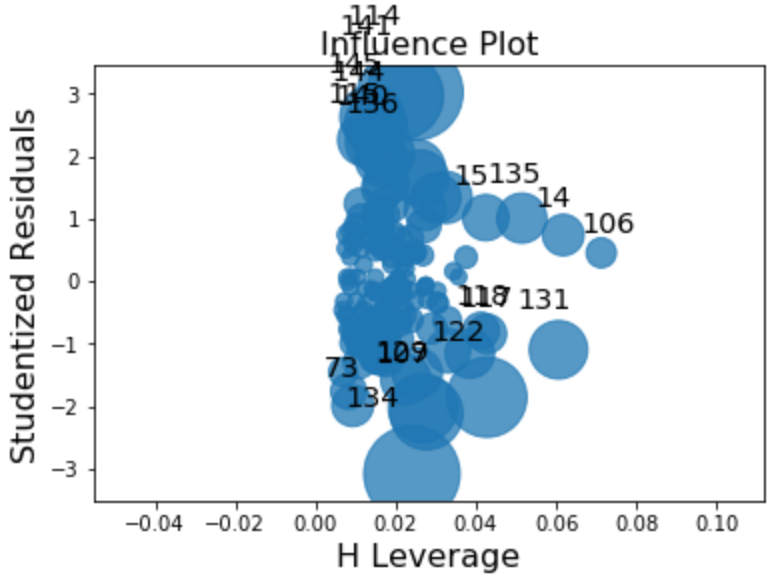
outlying values at the upper right corner or at the lower right corner

In [12]:
```
from statsmodels.graphics.regressionplots import *
plot_leverage_resid2(results)
influence_plot(results)
```

Out[12]:




Leverage vs. Normalized residuals squared
Leverage
Normalized residuals**2
106
14
131
135
122
107
136
140
115
73
144
145
141
134


Influence Plot
Studentized Residuals
H Leverage
15
135
14
106
131
122
73
134

In [ ]: