In [3]:
```
!pip install -e git+https://github.com/Shopify/bevel#egg=bevel
```

```
Obtaining bevel from git+https://github.com/Shopify/bevel#egg=bevel
  Running command git clone -q https://github.com/Shopify/bevel 'C:\Users
\Admin\src\bevel'
  Cloning https://github.com/Shopify/bevel to c:\users\admin\src\bevel
Installing collected packages: bevel
  Attempting uninstall: bevel
    Found existing installation: bevel 0.1.0
    Uninstalling bevel-0.1.0:
      Successfully uninstalled bevel-0.1.0
  Running setup.py develop for bevel
Successfully installed bevel
```

In [6]:
```
!pip install numdifftools
```

```
Collecting numdifftools
  Downloading numdifftools-0.9.40-py2.py3-none-any.whl (99 kB)
Collecting algopy>=0.4
  Downloading algopy-0.5.7.zip (189 kB)
Requirement already satisfied: scipy>=0.8 in c:\users\admin\anaconda3\lib
\site-packages (from numdifftools) (1.6.2)
Requirement already satisfied: statsmodels>=0.6 in c:\users\admin\anacond
a3\lib\site-packages (from numdifftools) (0.12.2)
Requirement already satisfied: numpy>=1.9 in c:\users\admin\anaconda3\lib
\site-packages (from numdifftools) (1.20.1)
Requirement already satisfied: pandas>=0.21 in c:\users\admin\anaconda3\l
ib\site-packages (from statsmodels>=0.6->numdifftools) (1.2.4)
Requirement already satisfied: patsy>=0.5 in c:\users\admin\anaconda3\lib
\site-packages (from statsmodels>=0.6->numdifftools) (0.5.1)
Requirement already satisfied: pytz>=2017.3 in c:\users\admin\anaconda3\l
ib\site-packages (from pandas>=0.21->statsmodels>=0.6->numdifftools) (202
1.1)
Requirement already satisfied: python-dateutil>=2.7.3 in c:\users\admin\a
naconda3\lib\site-packages (from pandas>=0.21->statsmodels>=0.6->numdifft
ools) (2.8.1)
Requirement already satisfied: six in c:\users\admin\anaconda3\lib\site-p
ackages (from patsy>=0.5->statsmodels>=0.6->numdifftools) (1.15.0)
Building wheels for collected packages: algopy
  Building wheel for algopy (setup.py): started
  Building wheel for algopy (setup.py): finished with status 'done'
  Created wheel for algopy: filename=algopy-0.5.7-py3-none-any.whl size=1
07616 sha256=042008aee41cc24ac4e87f530312ef9fb754ce04e3220b56196797b62f09
b8e2
  Stored in directory: c:\users\admin\appdata\local\pip\cache\wheels\0d\1
8\4f\be14421713ec96521183a9f4dc86becb3e6c1bf1b5578a4e57
Successfully built algopy
Installing collected packages: algopy, numdifftools
Successfully installed algopy-0.5.7 numdifftools-0.9.40
```

In [4]:
```
from bevel.linear_ordinal_regression import OrderedLogit
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import statsmodels.api as sm
import statsmodels.formula.api as sf
import numpy as np
```

In [5]:
```
wines = pd.read_csv(r'C:\Users\Admin\OneDrive\Рабочий стол\DataScience\w
```

In [6]:
```
wines.head()
```

Out[6]:

| | fixed acidity | volatile acidity | citric acid | residual sugar | chlorides | free sulfur dioxide | total sulfur dioxide | density | pH | sulphates | al |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 7.4 | 0.70 | 0.00 | 1.9 | 0.076 | 11.0 | 34.0 | 0.9978 | 3.51 | 0.56 | |
| **1** | 7.8 | 0.88 | 0.00 | 2.6 | 0.098 | 25.0 | 67.0 | 0.9968 | 3.20 | 0.68 | |
| **2** | 7.8 | 0.76 | 0.04 | 2.3 | 0.092 | 15.0 | 54.0 | 0.9970 | 3.26 | 0.65 | |
| **3** | 11.2 | 0.28 | 0.56 | 1.9 | 0.075 | 17.0 | 60.0 | 0.9980 | 3.16 | 0.58 | |
| **4** | 7.4 | 0.70 | 0.00 | 1.9 | 0.076 | 11.0 | 34.0 | 0.9978 | 3.51 | 0.56 | |

Let's look at the distribution of ratings (the "quality" variable)

In [7]:
```
Y = wines.quality
X = wines.drop('quality', axis = 1)
```

In [8]:
```
ol = OrderedLogit()
ol.fit(X,Y)
ol.print_summary()
```

```
n=1599
                             beta   se(beta)        p  lower 0.95  upper 0.95
attribute names
fixed acidity              0.1284     0.0823   0.1188     -0.0329      0.2898
volatile acidity          -3.3957     0.4031   0.0000     -4.1857     -2.6058  *
**
citric acid               -0.8022     0.4622   0.0827     -1.7081      0.1038
.
residual sugar             0.0878     0.0480   0.0670     -0.0062      0.1818
.
chlorides                 -5.1416     1.3595   0.0002     -7.8062     -2.4770  *
**
free sulfur dioxide        0.0137     0.0068   0.0444      0.0003      0.0270
*
total sulfur dioxide      -0.0111     0.0024   0.0000     -0.0158     -0.0065  *
**
density                 -76.5142    68.3658   0.2631   -210.5088     57.4803
pH                       -0.8469     0.6009   0.1587     -2.0246      0.3309
sulphates                 2.9016     0.3675   0.0000      2.1814      3.6218  *
**
alcohol                   0.8308     0.0852   0.0000      0.6637      0.9978  *
**
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Somers' D = 0.481
```

- 'Somers D' can be interpreted as R^2 in a standard logistic regression but this indicator is for Ordinal Regression. The closer D to 1 the better our model becomes.

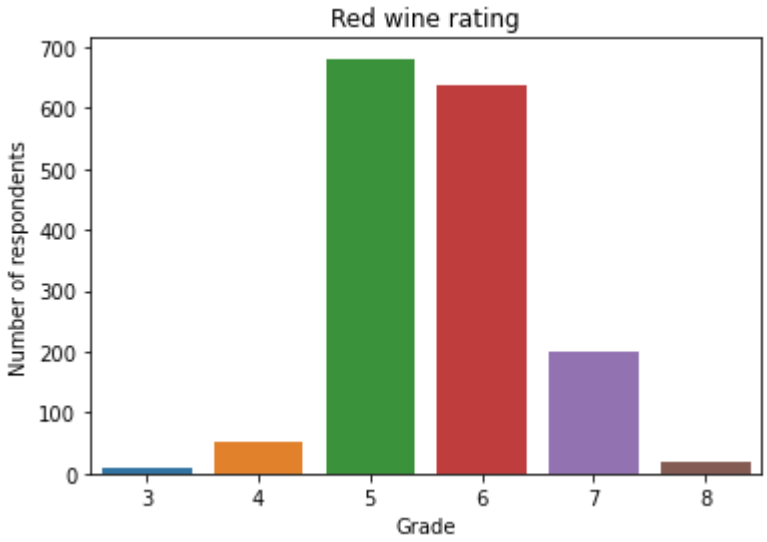
- First of all, we can see that 'volatile acidity', 'chlorides' and slightly 'total sulfur dioxide' negatively have an influence on the total grades of wines.

*Secondly, we can observe that 'sulfates' and 'alcohol' affect positively on the grades of the wines. It stands to reason that we considered D-indicator and p-value.

In [9]:
```
```

```
sns.countplot(x = 'quality', data = wines)
plt.xlabel('Grade')
plt.ylabel('Number of respondents')
plt.title('Red wine rating')
```

Out[9]: Text(0.5, 1.0, 'Red wine rating')




In [ ]: