In [1]:
```python
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score, confusion_matrix,classification_report
from sklearn.naive_bayes import BernoulliNB
from sklearn.naive_bayes import GaussianNB
from sklearn.naive_bayes import MultinomialNB
```

In [2]:
```python
data = pd.read_csv('D:\\24 - Machine_Learning\\download files\\glass.data',sep=',')
data
```

Out[2]:

	1	1.52101	13.64	4.49	1.10	71.78	0.06	8.75	0.00	0.00.1	1.1
0	2	1.51761	13.89	3.60	1.36	72.73	0.48	7.83	0.00	0.00	1
1	3	1.51618	13.53	3.55	1.54	72.99	0.39	7.78	0.00	0.00	1
2	4	1.51766	13.21	3.69	1.29	72.61	0.57	8.22	0.00	0.00	1
3	5	1.51742	13.27	3.62	1.24	73.08	0.55	8.07	0.00	0.00	1
4	6	1.51596	12.79	3.61	1.62	72.97	0.64	8.07	0.00	0.26	1
...	...	...	...	...	...	...	...	...	...	...	...
208	210	1.51623	14.14	0.00	2.88	72.61	0.08	9.18	1.06	0.00	7
209	211	1.51685	14.92	0.00	1.99	73.06	0.00	8.40	1.59	0.00	7
210	212	1.52065	14.36	0.00	2.02	73.42	0.00	8.44	1.64	0.00	7
211	213	1.51651	14.38	0.00	1.94	73.61	0.00	8.48	1.57	0.00	7
212	214	1.51711	14.23	0.00	2.08	73.36	0.00	8.62	1.67	0.00	7

213 rows × 11 columns

In [3]:
```python
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 213 entries, 0 to 212
Data columns (total 11 columns):
 #   Column   Non-Null Count  Dtype
---  ------   --------------  -----
 0   1        213 non-null    int64
 1   1.52101  213 non-null    float64
 2   13.64    213 non-null    float64
 3   4.49     213 non-null    float64
 4   1.10     213 non-null    float64
 5   71.78    213 non-null    float64
 6   0.06     213 non-null    float64
 7   8.75     213 non-null    float64
 8   0.00     213 non-null    float64
 9   0.00.1   213 non-null    float64
 10  1.1      213 non-null    int64
dtypes: float64(9), int64(2)
memory usage: 18.4 KB
```

In [4]:
```python
col_names = ['Id','RI','NA','Mg','Al','Si','K','Ca','Ba','Fe','Type']
```

In [5]:
```python
data.columns = col_names
```

In [6]:
```python
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 213 entries, 0 to 212
Data columns (total 11 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   Id      213 non-null    int64
 1   RI      213 non-null    float64
 2   NA      213 non-null    float64
 3   Mg      213 non-null    float64
 4   Al      213 non-null    float64
 5   Si      213 non-null    float64
 6   K       213 non-null    float64
 7   Ca      213 non-null    float64
 8   Ba      213 non-null    float64
 9   Fe      213 non-null    float64
 10  Type    213 non-null    int64
dtypes: float64(9), int64(2)
memory usage: 18.4 KB
```

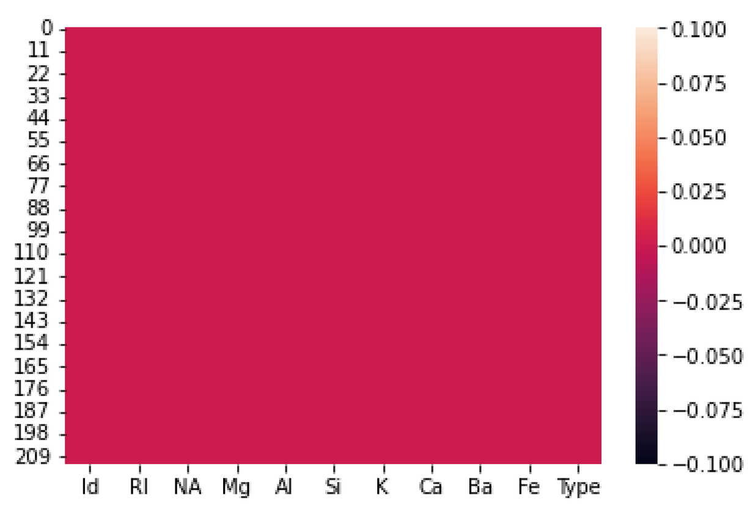
In [7]:
```python
data
```

Out[7]:

	Id	RI	NA	Mg	Al	Si	K	Ca	Ba	Fe	Type
0	2	1.51761	13.89	3.60	1.36	72.73	0.48	7.83	0.00	0.00	1
1	3	1.51618	13.53	3.55	1.54	72.99	0.39	7.78	0.00	0.00	1
2	4	1.51766	13.21	3.69	1.29	72.61	0.57	8.22	0.00	0.00	1
3	5	1.51742	13.27	3.62	1.24	73.08	0.55	8.07	0.00	0.00	1
4	6	1.51596	12.79	3.61	1.62	72.97	0.64	8.07	0.00	0.26	1
...	...	...	...	...	...	...	...	...	...	...	...
208	210	1.51623	14.14	0.00	2.88	72.61	0.08	9.18	1.06	0.00	7
209	211	1.51685	14.92	0.00	1.99	73.06	0.00	8.40	1.59	0.00	7
210	212	1.52065	14.36	0.00	2.02	73.42	0.00	8.44	1.64	0.00	7
211	213	1.51651	14.38	0.00	1.94	73.61	0.00	8.48	1.57	0.00	7
212	214	1.51711	14.23	0.00	2.08	73.36	0.00	8.62	1.67	0.00	7

213 rows × 11 columns

In [8]:
```python
sns.heatmap(data.isna());
```



In [9]:
```python
cor = data.corr()
cor
```

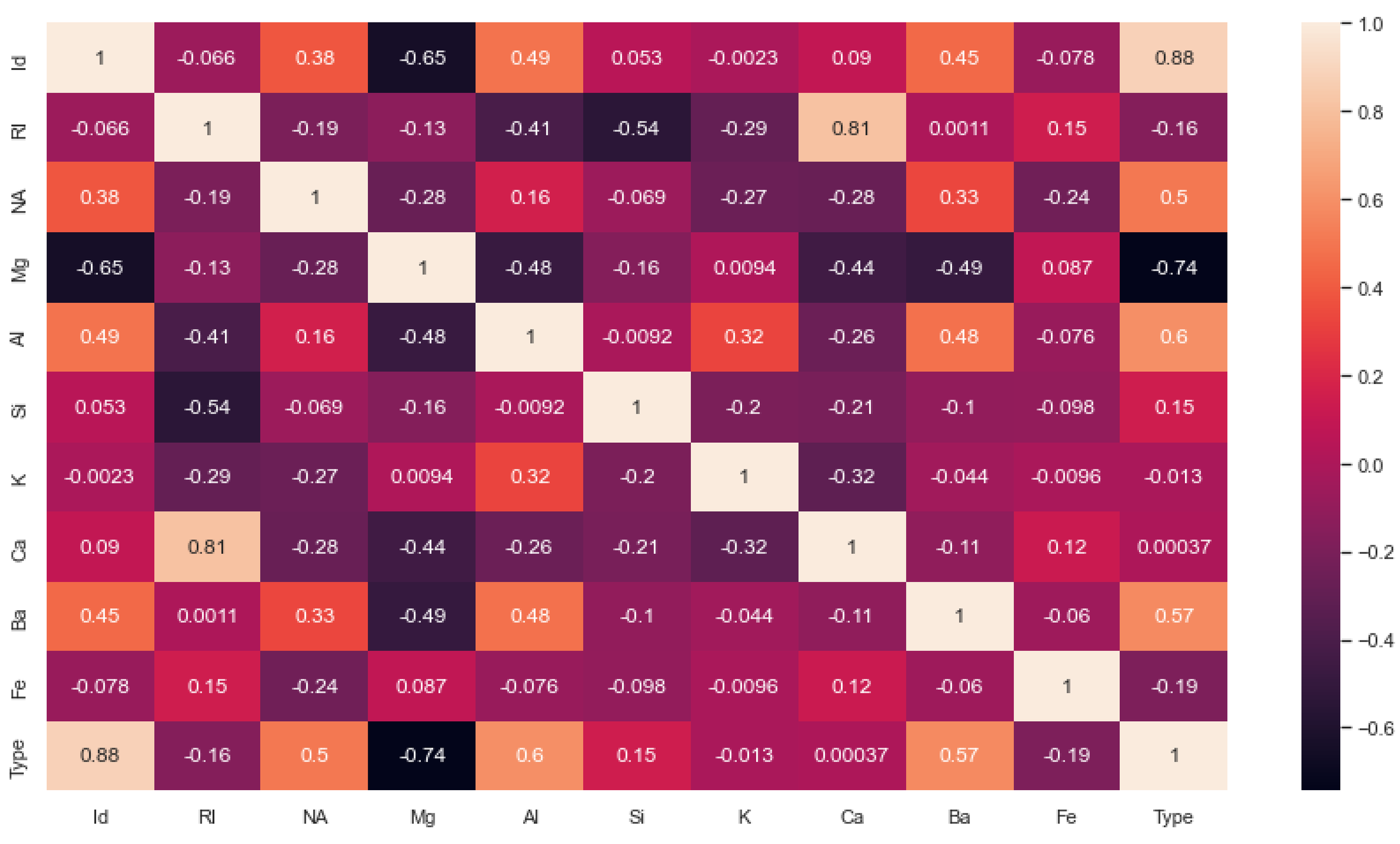
Out[9]:

	Id	RI	NA	Mg	Al	Si	K	Ca	Ba	Fe	Type
Id	1.000000	-0.065721	0.380767	-0.647082	0.488475	0.052634	-0.002306	0.090257	0.451437	-0.078151	0.878113
RI	-0.065721	1.000000	-0.193436	-0.128118	-0.405671	-0.540010	-0.287900	0.812495	0.001062	0.145791	-0.161322
NA	0.380767	-0.193436	1.000000	-0.276486	0.157928	-0.068519	-0.265520	-0.275314	0.327233	-0.240802	0.504983
Mg	-0.647082	-0.128118	-0.276486	1.000000	-0.480035	-0.160359	0.009397	-0.444559	-0.492149	0.086906	-0.744004
Al	0.488475	-0.405671	0.157928	-0.480035	1.000000	-0.009226	0.324484	-0.260372	0.478936	-0.076456	0.597754
Si	0.052634	-0.540010	-0.068519	-0.160359	-0.009226	1.000000	-0.197684	-0.210141	-0.104361	-0.097674	0.147767
K	-0.002306	-0.287900	-0.265520	0.009397	0.324484	-0.197684	1.000000	-0.318649	-0.043790	-0.009586	-0.012765
Ca	0.090257	0.812495	-0.275314	-0.444559	-0.260372	-0.210141	-0.318649	1.000000	-0.113121	0.124674	0.000372
Ba	0.451437	0.001062	0.327233	-0.492149	0.478936	-0.104361	-0.043790	-0.113121	1.000000	-0.059729	0.574896
Fe	-0.078151	0.145791	-0.240802	0.086906	-0.076456	-0.097674	-0.009586	0.124674	-0.059729	1.000000	-0.191090
Type	0.878113	-0.161322	0.504983	-0.744004	0.597754	0.147767	-0.012765	0.000372	0.574896	-0.191090	1.000000

In [10]:
```python
sns.set(rc = {'figure.figsize':(15,8)})
sns.heatmap(cor,annot=True)
```

Out[10]:

```
<AxesSubplot:>
```



In [ ]:

In [11]:
```python
nb = BernoulliNB()
gnb = GaussianNB()
mnb = MultinomialNB()
```

In [12]:
```python
x = data.drop(columns=['Type'])
y = data['Type']
```

In [13]:
```python
xtrain,xtest,ytrain,ytest = train_test_split(x,y,test_size=0.2, random_state=4)
```

In [14]:
```python
nb.fit(xtrain, ytrain)
gnb.fit(xtrain, ytrain)
mnb.fit(xtrain, ytrain)
```

Out[14]:

```
MultinomialNB()
```

In [15]:
```python
ypred = nb.predict(xtest)
```

In [16]:
```python
accuracy_score(ytest,ypred)
```

Out[16]:

```
0.4883720930232558
```

In [17]:
```python
print(classification_report(ytest,ypred))
```

```
              precision    recall  f1-score   support

           1       0.39      0.92      0.55        13
           2       0.67      0.11      0.19        18
           5       0.00      0.00      0.00         4
           6       0.50      1.00      0.67         1
           7       0.86      0.86      0.86         7

    accuracy                           0.49        43
   macro avg       0.48      0.58      0.45        43
weighted avg       0.55      0.49      0.40        43
```

```
D:\24-Annaconda\lib\site-packages\sklearn\metrics\_classification.py:1318: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted sa
mples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
D:\24-Annaconda\lib\site-packages\sklearn\metrics\_classification.py:1318: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted sa
mples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
D:\24-Annaconda\lib\site-packages\sklearn\metrics\_classification.py:1318: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted sa
mples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

In [18]:
```python
sns.heatmap (cf,annot=True)
plt.axis('equal')
plt.show()
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Input In [18], in <cell line: 1>()
----> 1 sns.heatmap (cf,annot=True)
      2 plt.axis('equal')
      3 plt.show()

NameError: name 'cf' is not defined
```

In [ ]:
```python
cf = confusion_matrix(ytest,ypred)
cf
```

In [ ]:
```python
ypred = gnb.predict(xtest)
```

In [ ]:
```python
accuracy_score(ytest,ypred)
```

In [ ]:
```python
print(classification_report(ytest,ypred))
```

In [ ]:
```python
sns.heatmap (cf,annot=True)
plt.axis('equal')
plt.show()
```

In [ ]:
```python
cf = confusion_matrix(ytest,ypred)
cf
```

In [ ]:
```python
ypred = mnb.predict(xtest)
```

In [ ]:
```python
accuracy_score(ytest,ypred)
```

In [ ]:
```python
print(classification_report(ytest,ypred))
```

In [ ]:
```python
cf = confusion_matrix(ytest,ypred)
cf
```

In [ ]:
```python
sn.heatmap (cf,annot=True)
plt.axis('equal')
plt.show()
```

The accuracy BernoulliNB is 0.4883720930232558 The accuracy GaussianNB is 0.7906976744186046 The accuracy MultinomialNB is 0.7906976744186046