```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

```python
data = pd.read_csv("glass.csv")
```

```python
data.columns
```

Index(['RI', 'Na', 'Mg', 'Al', 'Si', 'K', 'Ca', 'Ba', 'Fe', 'Type'], dtype='o

```python
print(len(data.columns))
```

10

```python
data.head()
```

	RI	Na	Mg	Al	Si	K	Ca	Ba	Fe	Type
0	1.52101	13.64	4.49	1.10	71.78	0.06	8.75	0.0	0.0	1
1	1.51761	13.89	3.60	1.36	72.73	0.48	7.83	0.0	0.0	1
2	1.51618	13.53	3.55	1.54	72.99	0.39	7.78	0.0	0.0	1
3	1.51766	13.21	3.69	1.29	72.61	0.57	8.22	0.0	0.0	1
4	1.51742	13.27	3.62	1.24	73.08	0.55	8.07	0.0	0.0	1

```python
data.head(7)
```

	RI	Na	Mg	Al	Si	K	Ca	Ba	Fe	Type
0	1.52101	13.64	4.49	1.10	71.78	0.06	8.75	0.0	0.00	1
1	1.51761	13.89	3.60	1.36	72.73	0.48	7.83	0.0	0.00	1
2	1.51618	13.53	3.55	1.54	72.99	0.39	7.78	0.0	0.00	1
3	1.51766	13.21	3.69	1.29	72.61	0.57	8.22	0.0	0.00	1
4	1.51742	13.27	3.62	1.24	73.08	0.55	8.07	0.0	0.00	1
5	1.51596	12.79	3.61	1.62	72.97	0.64	8.07	0.0	0.26	1
6	1.51743	13.30	3.60	1.14	73.09	0.58	8.17	0.0	0.00	1

```python
data.describe()
```

	RI	Na	Mg	Al	Si	K	
count	214.000000	214.000000	214.000000	214.000000	214.000000	214.000000	214.0000
mean	1.518365	13.407850	2.684533	1.444907	72.650935	0.497056	8.9569
std	0.003037	0.816604	1.442408	0.499270	0.774546	0.652192	1.4231
min	1.511150	10.730000	0.000000	0.290000	69.810000	0.000000	5.4300
25%	1.516523	12.907500	2.115000	1.190000	72.280000	0.122500	8.2400

```
data.Type.unique()
```

```
array([1, 2, 3, 5, 6, 7])
```

```
grouped = data.groupby('Type')
for col,group in grouped:
    print(col)
    print(group)
```

```
1
         RI     Na    Mg    Al     Si     K     Ca    Ba    Fe  Type
0    1.52101  13.64  4.49  1.10  71.78  0.06   8.75  0.0  0.00     1
1    1.51761  13.89  3.60  1.36  72.73  0.48   7.83  0.0  0.00     1
2    1.51618  13.53  3.55  1.54  72.99  0.39   7.78  0.0  0.00     1
3    1.51766  13.21  3.69  1.29  72.61  0.57   8.22  0.0  0.00     1
4    1.51742  13.27  3.62  1.24  73.08  0.55   8.07  0.0  0.00     1
..       ...    ...   ...   ...    ...   ...    ...  ...   ...   ...
65   1.52099  13.69  3.59  1.12  71.96  0.09   9.40  0.0  0.00     1
66   1.52152  13.05  3.65  0.87  72.22  0.19   9.85  0.0  0.17     1
67   1.52152  13.05  3.65  0.87  72.32  0.19   9.85  0.0  0.17     1
68   1.52152  13.12  3.58  0.90  72.20  0.23   9.82  0.0  0.16     1
69   1.52300  13.31  3.58  0.82  71.99  0.12  10.17  0.0  0.03     1

[70 rows x 10 columns]
2
         RI     Na    Mg    Al     Si     K     Ca    Ba    Fe  Type
70   1.51574  14.86  3.67  1.74  71.87  0.16   7.36  0.00  0.12     2
71   1.51848  13.64  3.87  1.27  71.96  0.54   8.32  0.00  0.32     2
72   1.51593  13.09  3.59  1.52  73.10  0.67   7.83  0.00  0.00     2
73   1.51631  13.34  3.57  1.57  72.87  0.61   7.89  0.00  0.00     2
74   1.51596  13.02  3.56  1.54  73.11  0.72   7.90  0.00  0.00     2
..       ...    ...   ...   ...    ...   ...    ...   ...   ...   ...
141  1.51851  13.20  3.63  1.07  72.83  0.57   8.41  0.09  0.17     2
142  1.51662  12.85  3.51  1.44  73.01  0.68   8.23  0.06  0.25     2
143  1.51709  13.00  3.47  1.79  72.72  0.66   8.18  0.00  0.00     2
144  1.51660  12.99  3.18  1.23  72.97  0.58   8.81  0.00  0.24     2
145  1.51839  12.85  3.67  1.24  72.57  0.62   8.68  0.00  0.35     2

[76 rows x 10 columns]
3
         RI     Na    Mg    Al     Si     K     Ca    Ba    Fe  Type
146  1.51769  13.65  3.66  1.11  72.77  0.11   8.60  0.00  0.00     3
147  1.51610  13.33  3.53  1.34  72.67  0.56   8.33  0.00  0.00     3
148  1.51670  13.24  3.57  1.38  72.70  0.56   8.44  0.00  0.10     3
149  1.51643  12.16  3.52  1.35  72.89  0.57   8.53  0.00  0.00     3
150  1.51665  13.14  3.45  1.76  72.48  0.60   8.38  0.00  0.17     3
151  1.52127  14.32  3.90  0.83  71.50  0.00   9.49  0.00  0.00     3
152  1.51779  13.64  3.65  0.65  73.00  0.06   8.93  0.00  0.00     3
153  1.51610  13.42  3.40  1.22  72.69  0.59   8.32  0.00  0.00     3
154  1.51694  12.86  3.58  1.31  72.61  0.61   8.79  0.00  0.00     3
155  1.51646  13.04  3.40  1.26  73.01  0.52   8.58  0.00  0.00     3
156  1.51655  13.41  3.39  1.28  72.64  0.52   8.65  0.00  0.00     3
157  1.52121  14.03  3.76  0.58  71.79  0.11   9.65  0.00  0.00     3
158  1.51776  13.53  3.41  1.52  72.04  0.58   8.79  0.00  0.00     3
159  1.51796  13.50  3.36  1.63  71.94  0.57   8.81  0.00  0.09     3
160  1.51832  13.33  3.34  1.54  72.14  0.56   8.99  0.00  0.00     3
161  1.51934  13.64  3.54  0.75  72.65  0.16   8.89  0.15  0.24     3
162  1.52211  14.19  3.78  0.91  71.36  0.23   9.14  0.00  0.37     3
5
         RI     Na    Mg    Al     Si     K     Ca    Ba    Fe  Type
163  1.51514  14.01  2.68  3.50  69.89  1.68   5.87  2.20  0.00     5
164  1.51915  12.73  1.85  1.86  72.69  0.60  10.09  0.00  0.00     5
165  1.52171  11.56  1.88  1.56  72.86  0.47  11.41  0.00  0.00     5
166  1.52151  11.03  1.71  1.56  73.44  0.58  11.62  0.00  0.00     5
167  1.51969  12.64  0.00  1.65  73.75  0.38  11.53  0.00  0.00     5
168  1.51666  12.86  0.00  1.83  73.88  0.97  10.17  0.00  0.00     5
169  1.51994  13.27  0.00  1.76  73.03  0.47  11.32  0.00  0.00     5
```

```
170  1.52369  13.44  0.00  1.58  72.22  0.32  12.24  0.00  0.00     5
171  1.51316  13.02  0.00  3.04  70.48  6.21   6.96  0.00  0.00     5
172  1.51321  13.00  0.00  3.02  70.70  6.21   6.93  0.00  0.00     5
173  1.52043  13.38  0.00  1.40  72.25  0.33  12.50  0.00  0.00     5
174  1.52058  12.85  1.61  2.17  72.18  0.76   9.70  0.24  0.51     5
175  1.52119  12.97  0.33  1.51  73.39  0.13  11.27  0.00  0.28     5
6
          RI     Na    Mg    Al     Si    K     Ca   Ba   Fe  Type
176  1.51905  14.00  2.39  1.56  72.37  0.0   9.57  0.0  0.0     6
177  1.51937  13.79  2.41  1.19  72.76  0.0   9.77  0.0  0.0     6
178  1.51829  14.46  2.24  1.62  72.38  0.0   9.26  0.0  0.0     6
179  1.51852  14.09  2.19  1.66  72.67  0.0   9.32  0.0  0.0     6
180  1.51299  14.40  1.74  1.54  74.55  0.0   7.59  0.0  0.0     6
```

```python
for group in grouped:
    print(group[0])
    print(group[1].agg([np.sum, np.mean, np.std]),end = '\n\n\n')
```

```
1
             RI           Na           Mg           Al           Si            K
sum  106.310280   926.960000   248.670000    81.470000  5083.340000   31.320000
mean   1.518718    13.242286     3.552429     1.163857    72.619143    0.447429
std    0.002268     0.499301     0.247043     0.273158     0.569484    0.214879

             Ca           Ba           Fe  Type
sum  615.810000     0.890000     3.990000  70.0
mean   8.797286     0.012714     0.057000   1.0
std    0.574807     0.083838     0.089075   0.0


2
             RI           Na           Mg           Al           Si            K
sum  115.415010   996.490000   228.160000   107.020000  5517.450000   39.600000
mean   1.518619    13.111711     3.002105     1.408158    72.598026    0.521053
std    0.003802     0.664159     1.215661     0.318340     0.724573    0.213726

             Ca           Ba           Fe  Type
sum  689.600000     3.820000     6.060000  152.0
mean   9.073684     0.050263     0.079737    2.0
std    1.921635     0.362340     0.106433    0.0


3
             RI           Na           Mg           Al           Si            K  \
sum   25.805380   228.430000    60.240000    20.420000  1230.880000    6.910000
mean   1.517964    13.437059     3.543529     1.201176    72.404706    0.406471
std    0.001916     0.506887     0.162786     0.347489     0.512276    0.229890

             Ca           Ba           Fe  Type
sum  149.310000     0.150000     0.970000  51.0
mean   8.782941     0.008824     0.057059   3.0
```

```
data.sort_values(['Type', 'Ca', 'Mg', 'Na'],ascending=[True, False, False, False])
```

	RI	Na	Mg	Al	Si	K	Ca	Ba	Fe	Type
69	1.52300	13.31	3.58	0.82	71.99	0.12	10.17	0.0	0.03	1
50	1.52320	13.72	3.72	0.51	71.75	0.09	10.06	0.0	0.16	1
48	1.52223	13.21	3.77	0.79	71.99	0.13	10.02	0.0	0.00	1
66	1.52152	13.05	3.65	0.87	72.22	0.19	9.85	0.0	0.17	1
67	1.52152	13.05	3.65	0.87	72.32	0.19	9.85	0.0	0.17	1

```
data = data[['Ca', 'Mg', 'Na', 'Si', 'K', 'Al', 'RI', 'Ba', 'Fe', 'Type']]
data.head()
```

	Ca	Mg	Na	Si	K	Al	RI	Ba	Fe	Type
0	8.75	4.49	13.64	71.78	0.06	1.10	1.52101	0.0	0.0	1
1	7.83	3.60	13.89	72.73	0.48	1.36	1.51761	0.0	0.0	1

```
data.describe()
```

	Ca	Mg	Na	Si	K	Al	
count	214.000000	214.000000	214.000000	214.000000	214.000000	214.000000	214.0000
mean	8.956963	2.684533	13.407850	72.650935	0.497056	1.444907	1.5183
std	1.423153	1.442408	0.816604	0.774546	0.652192	0.499270	0.0030
min	5.430000	0.000000	10.730000	69.810000	0.000000	0.290000	1.5111
25%	8.240000	2.115000	12.907500	72.280000	0.122500	1.190000	1.5165
50%	8.600000	3.480000	13.300000	72.790000	0.555000	1.360000	1.5176
75%	9.172500	3.600000	13.825000	73.087500	0.610000	1.630000	1.5191
max	16.190000	4.490000	17.380000	75.410000	6.210000	3.500000	1.5339

```
grouped = data.groupby('Type')
for group in grouped:
    print(group[0])
    print(group[1].agg([np.mean, np.std]),end = '\n\n\n')
```

1
```
          Ca        Mg         Na         Si         K         Al         RI
mean  8.797286  3.552429  13.242286  72.619143  0.447429  1.163857  1.518718
std   0.574807  0.247043   0.499301   0.569484  0.214879  0.273158  0.002268

          Ba        Fe  Type
mean  0.012714  0.057000   1.0
std   0.083838  0.089075   0.0
```

2
```
          Ca        Mg         Na         Si         K         Al         RI
mean  9.073684  3.002105  13.111711  72.598026  0.521053  1.408158  1.518619
std   1.921635  1.215661   0.664159   0.724573  0.213726  0.318340  0.003802

          Ba        Fe  Type
mean  0.050263  0.079737   2.0
std   0.362340  0.106433   0.0
```

3
```
          Ca        Mg         Na         Si         K         Al         RI
mean  8.782941  3.543529  13.437059  72.404706  0.406471  1.201176  1.517964
std   0.380111  0.162786   0.506887   0.512276  0.229890  0.347489  0.001916

          Ba        Fe  Type
mean  0.008824  0.057059   3.0
std   0.036380  0.107864   0.0
```

5
```
           Ca        Mg         Na         Si         K         Al         RI
mean  10.123846  0.773846  12.827692  72.366154  1.470000  2.033846  1.518928
```

```python
data.drop(["Si"], axis = 1, inplace = True)
data
```

	Ca	Mg	Na	K	Al	RI	Ba	Fe	Type

```
data.head()
```

	Ca	Mg	Na	K	Al	RI	Ba	Fe	Type
0	8.75	4.49	13.64	0.06	1.10	1.52101	0.0	0.0	1
1	7.83	3.60	13.89	0.48	1.36	1.51761	0.0	0.0	1
2	7.78	3.55	13.53	0.39	1.54	1.51618	0.0	0.0	1
3	8.22	3.69	13.21	0.57	1.29	1.51766	0.0	0.0	1
4	8.07	3.62	13.27	0.55	1.24	1.51742	0.0	0.0	1
211	8.44	0.00	14.36	0.00	2.02	1.52065	1.64	0.0	7

```
data.drop(data.index[[1,3]]).head()
```

	Ca	Mg	Na	K	Al	RI	Ba	Fe	Type
0	8.75	4.49	13.64	0.06	1.10	1.52101	0.0	0.00	1
2	7.78	3.55	13.53	0.39	1.54	1.51618	0.0	0.00	1
4	8.07	3.62	13.27	0.55	1.24	1.51742	0.0	0.00	1
5	8.07	3.61	12.79	0.64	1.62	1.51596	0.0	0.26	1
6	8.17	3.60	13.30	0.58	1.14	1.51743	0.0	0.00	1