Air Quality

July 5, 2023

[1]:
```
import pandas as pd
import os
%matplotlib inline
```

[2]:
```
os.chdir("C:\\Users\ddaya\OneDrive\Documents\Python_programming")
air_quality=pd.read_csv("air_quality_no2.csv",index_col=0,parse_dates=True)
```

[3]:
```
air_quality
```

[3]:
```
                     station_antwerp  station_paris  station_london
datetime
2019-05-07 02:00:00              NaN            NaN            23.0
2019-05-07 03:00:00             50.5           25.0            19.0
2019-05-07 04:00:00             45.0           27.7            19.0
2019-05-07 05:00:00              NaN           50.4            16.0
2019-05-07 06:00:00              NaN           61.9             NaN
…                                …              …               …
2019-06-20 22:00:00              NaN           21.4             NaN
2019-06-20 23:00:00              NaN           24.9             NaN
2019-06-21 00:00:00              NaN           26.5             NaN
2019-06-21 01:00:00              NaN           21.8             NaN
2019-06-21 02:00:00              NaN           20.0             NaN

[1035 rows x 3 columns]
```

[4]:
```
# How to create new columns derived from existing columns?
air_quality["london_mg_per_cubic"]=air_quality["station_london"]*1.882
```

[5]:
```
air_quality
```

[5]:
```
                     station_antwerp  station_paris  station_london  \
datetime
2019-05-07 02:00:00              NaN            NaN            23.0
2019-05-07 03:00:00             50.5           25.0            19.0
2019-05-07 04:00:00             45.0           27.7            19.0
2019-05-07 05:00:00              NaN           50.4            16.0
2019-05-07 06:00:00              NaN           61.9             NaN
…                                …              …               …
```

```
2019-06-20 22:00:00              NaN           21.4             NaN
2019-06-20 23:00:00              NaN           24.9             NaN
2019-06-21 00:00:00              NaN           26.5             NaN
2019-06-21 01:00:00              NaN           21.8             NaN
2019-06-21 02:00:00              NaN           20.0             NaN

                     london_mg_per_cubic
datetime
2019-05-07 02:00:00               43.286
2019-05-07 03:00:00               35.758
2019-05-07 04:00:00               35.758
2019-05-07 05:00:00               30.112
2019-05-07 06:00:00                  NaN
…                                     …
2019-06-20 22:00:00                  NaN
2019-06-20 23:00:00                  NaN
2019-06-21 00:00:00                  NaN
2019-06-21 01:00:00                  NaN
2019-06-21 02:00:00                  NaN

[1035 rows x 4 columns]
```

[6]:
```
air_quality["ration_paris_antwerp"]=(
air_quality["station_paris"]/air_quality["station_antwerp"])
```

[7]:
```
air_quality
```

[7]:
```
                     station_antwerp  station_paris  station_london  \
datetime
2019-05-07 02:00:00              NaN            NaN            23.0
2019-05-07 03:00:00             50.5           25.0            19.0
2019-05-07 04:00:00             45.0           27.7            19.0
2019-05-07 05:00:00              NaN           50.4            16.0
2019-05-07 06:00:00              NaN           61.9             NaN
…                                …              …               …
2019-06-20 22:00:00              NaN           21.4             NaN
2019-06-20 23:00:00              NaN           24.9             NaN
2019-06-21 00:00:00              NaN           26.5             NaN
2019-06-21 01:00:00              NaN           21.8             NaN
2019-06-21 02:00:00              NaN           20.0             NaN

                     london_mg_per_cubic  ration_paris_antwerp
datetime
2019-05-07 02:00:00               43.286                   NaN
2019-05-07 03:00:00               35.758              0.495050
2019-05-07 04:00:00               35.758              0.615556
2019-05-07 05:00:00               30.112                   NaN
```

```
2019-05-07 06:00:00                  NaN                    NaN
…                                    …                      …
2019-06-20 22:00:00                  NaN                    NaN
2019-06-20 23:00:00                  NaN                    NaN
2019-06-21 00:00:00                  NaN                    NaN
2019-06-21 01:00:00                  NaN                    NaN
2019-06-21 02:00:00                  NaN                    NaN

[1035 rows x 5 columns]
```

[8]:
```
air_quality_rename=air_quality.rename(
    columns={
        "station_antwerp":"BETR801",
        "station_paris":"FR0414",
        "station_london":"London Westminster",
    })
```

[9]:
```
air_quality_rename
```

[9]:
```
                     BETR801  FR0414  London Westminster  london_mg_per_cubic  \
datetime
2019-05-07 02:00:00      NaN     NaN                23.0               43.286
2019-05-07 03:00:00     50.5    25.0                19.0               35.758
2019-05-07 04:00:00     45.0    27.7                19.0               35.758
2019-05-07 05:00:00      NaN    50.4                16.0               30.112
2019-05-07 06:00:00      NaN    61.9                 NaN                  NaN
…                        …      …                   …                    …
2019-06-20 22:00:00      NaN    21.4                 NaN                  NaN
2019-06-20 23:00:00      NaN    24.9                 NaN                  NaN
2019-06-21 00:00:00      NaN    26.5                 NaN                  NaN
2019-06-21 01:00:00      NaN    21.8                 NaN                  NaN
2019-06-21 02:00:00      NaN    20.0                 NaN                  NaN

                     ration_paris_antwerp
datetime
2019-05-07 02:00:00                   NaN
2019-05-07 03:00:00              0.495050
2019-05-07 04:00:00              0.615556
2019-05-07 05:00:00                   NaN
2019-05-07 06:00:00                   NaN
…                                     …
2019-06-20 22:00:00                   NaN
2019-06-20 23:00:00                   NaN
2019-06-21 00:00:00                   NaN
2019-06-21 01:00:00                   NaN
2019-06-21 02:00:00                   NaN
```

```
[1035 rows x 5 columns]
```

[10]:
```
air_quality_rename.head()
```

[10]:
```
                     BETR801  FR0414  London Westminster  london_mg_per_cubic  \
datetime
2019-05-07 02:00:00      NaN     NaN                23.0               43.286
2019-05-07 03:00:00     50.5    25.0                19.0               35.758
2019-05-07 04:00:00     45.0    27.7                19.0               35.758
2019-05-07 05:00:00      NaN    50.4                16.0               30.112
2019-05-07 06:00:00      NaN    61.9                 NaN                  NaN

                     ration_paris_antwerp
datetime
2019-05-07 02:00:00                   NaN
2019-05-07 03:00:00              0.495050
2019-05-07 04:00:00              0.615556
2019-05-07 05:00:00                   NaN
2019-05-07 06:00:00                   NaN
```

[11]:
```
air_quality_rename=air_quality_rename.rename(columns=str.lower)
```

[12]:
```
air_quality_rename
```

[12]:
```
                     betr801  fr0414  london westminster  london_mg_per_cubic  \
datetime
2019-05-07 02:00:00      NaN     NaN                23.0               43.286
2019-05-07 03:00:00     50.5    25.0                19.0               35.758
2019-05-07 04:00:00     45.0    27.7                19.0               35.758
2019-05-07 05:00:00      NaN    50.4                16.0               30.112
2019-05-07 06:00:00      NaN    61.9                 NaN                  NaN
…                        …       …                   …                    …
2019-06-20 22:00:00      NaN    21.4                 NaN                  NaN
2019-06-20 23:00:00      NaN    24.9                 NaN                  NaN
2019-06-21 00:00:00      NaN    26.5                 NaN                  NaN
2019-06-21 01:00:00      NaN    21.8                 NaN                  NaN
2019-06-21 02:00:00      NaN    20.0                 NaN                  NaN

                     ration_paris_antwerp
datetime
2019-05-07 02:00:00                   NaN
2019-05-07 03:00:00              0.495050
2019-05-07 04:00:00              0.615556
2019-05-07 05:00:00                   NaN
2019-05-07 06:00:00                   NaN
…                                       …
2019-06-20 22:00:00                   NaN
```

```
2019-06-20 23:00:00                    NaN
2019-06-21 00:00:00                    NaN
2019-06-21 01:00:00                    NaN
2019-06-21 02:00:00                    NaN

[1035 rows x 5 columns]
```

1 Air quality Long

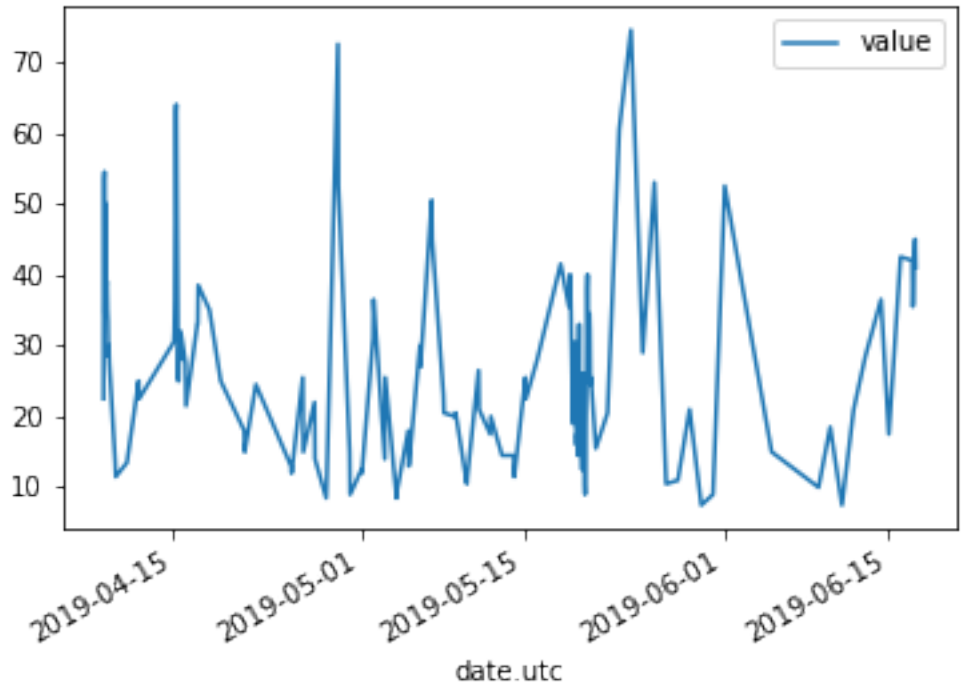
[13]:
```
air_quality=pd.read_csv("air_quality_long.csv",index_col="date.
↪utc",parse_dates=True)
```

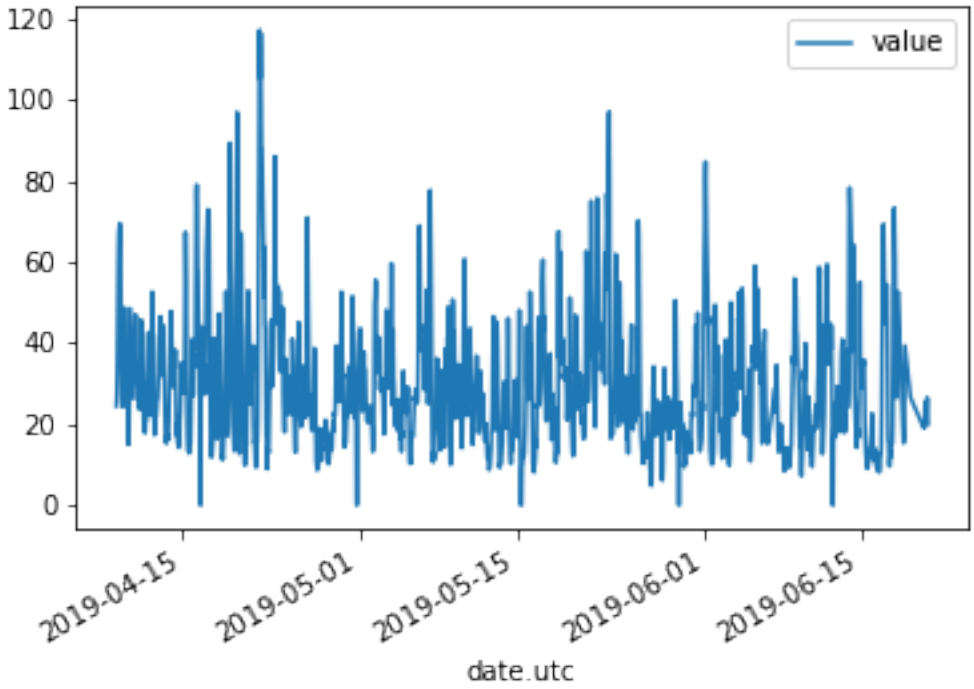
[14]:
```
air_quality
```

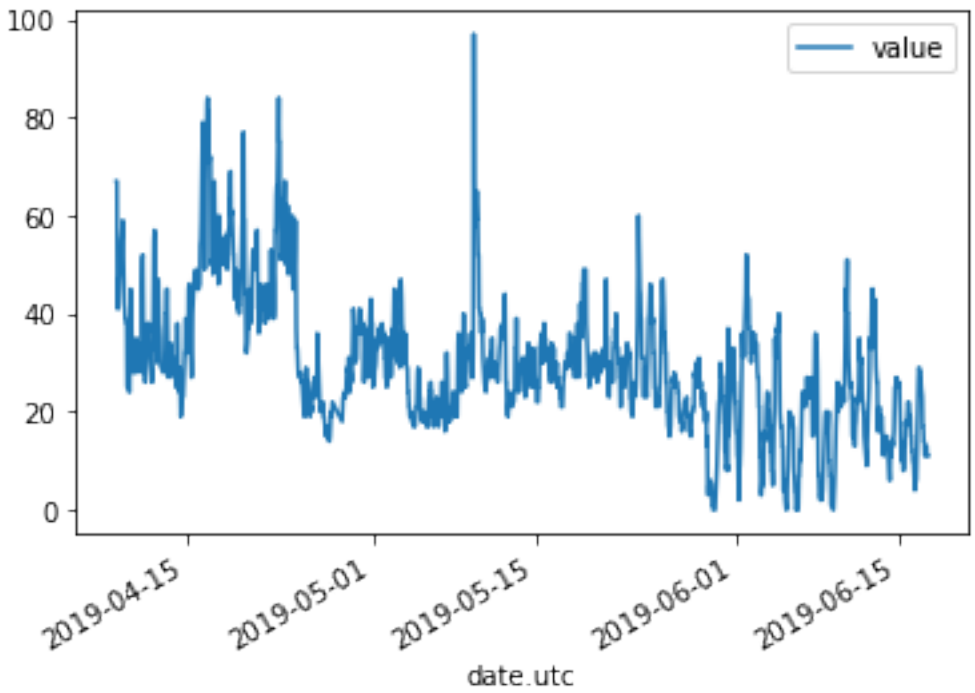
[14]:
```
                                 city country            location parameter  \
date.utc
2019-06-18 06:00:00+00:00  Antwerpen      BE             BETR801      pm25
2019-06-17 08:00:00+00:00  Antwerpen      BE             BETR801      pm25
2019-06-17 07:00:00+00:00  Antwerpen      BE             BETR801      pm25
2019-06-17 06:00:00+00:00  Antwerpen      BE             BETR801      pm25
2019-06-17 05:00:00+00:00  Antwerpen      BE             BETR801      pm25
…                                …     …                  …       …
2019-04-09 06:00:00+00:00     London      GB  London Westminster       no2
2019-04-09 05:00:00+00:00     London      GB  London Westminster       no2
2019-04-09 04:00:00+00:00     London      GB  London Westminster       no2
2019-04-09 03:00:00+00:00     London      GB  London Westminster       no2
2019-04-09 02:00:00+00:00     London      GB  London Westminster       no2

                           value   unit
date.utc
2019-06-18 06:00:00+00:00   18.0  µg/m³
2019-06-17 08:00:00+00:00    6.5  µg/m³
2019-06-17 07:00:00+00:00   18.5  µg/m³
2019-06-17 06:00:00+00:00   16.0  µg/m³
2019-06-17 05:00:00+00:00    7.5  µg/m³
…                            …    …
2019-04-09 06:00:00+00:00   41.0  µg/m³
2019-04-09 05:00:00+00:00   41.0  µg/m³
2019-04-09 04:00:00+00:00   41.0  µg/m³
2019-04-09 03:00:00+00:00   67.0  µg/m³
2019-04-09 02:00:00+00:00   67.0  µg/m³

[5272 rows x 6 columns]
```

[15]:
```
no2=air_quality[air_quality["parameter"]=="no2"]
```

[16]:
```
no2_subset=no2.sort_index().groupby(["location"]).plot()
```





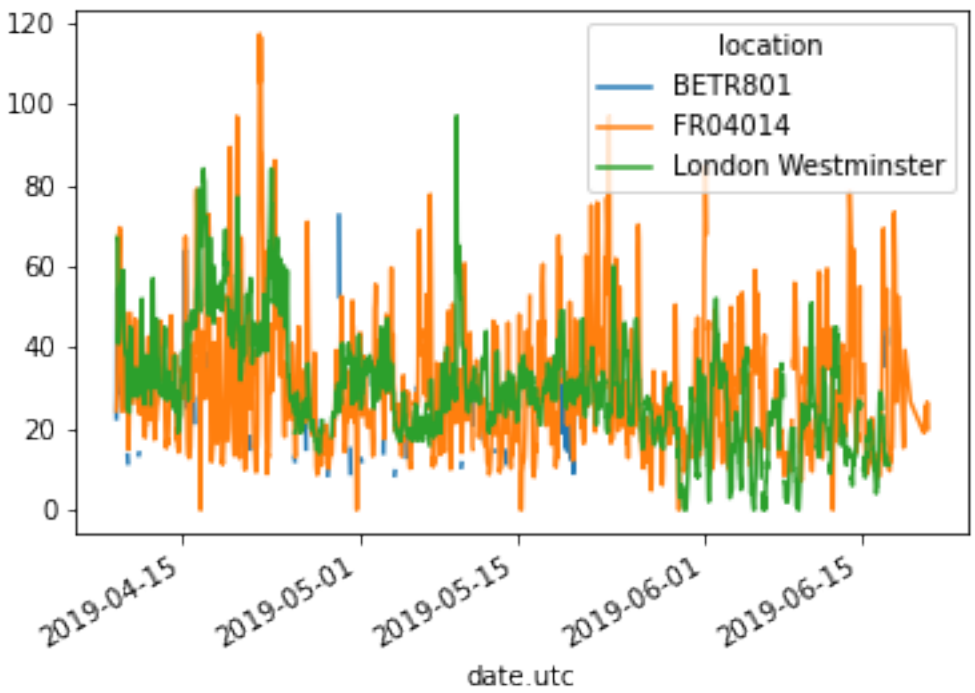


[23]:
```
no2.pivot(columns="location", values="value")
```

[23]:
```
location                   BETR801  FR04014  London Westminster
date.utc
2019-04-09 01:00:00+00:00     22.5     24.4                 NaN
2019-04-09 02:00:00+00:00     53.5     27.4                67.0
2019-04-09 03:00:00+00:00     54.5     34.2                67.0
2019-04-09 04:00:00+00:00     34.5     48.5                41.0
2019-04-09 05:00:00+00:00     46.5     59.5                41.0
…                              …        …                   …
2019-06-20 20:00:00+00:00      NaN     21.4                 NaN
2019-06-20 21:00:00+00:00      NaN     24.9                 NaN
2019-06-20 22:00:00+00:00      NaN     26.5                 NaN
2019-06-20 23:00:00+00:00      NaN     21.8                 NaN
2019-06-21 00:00:00+00:00      NaN     20.0                 NaN

[1705 rows x 3 columns]
```

[19]:
```
no2.pivot(columns="location",values="value").plot()
```

[19]:
```
<AxesSubplot:xlabel='date.utc'>
```



[24]:
```
air_quality
```

[24]:

date.utc	city	country	location	parameter	value	unit
2019-06-18 06:00:00+00:00	Antwerpen	BE	BETR801	pm25	18.0	µg/m³
2019-06-17 08:00:00+00:00	Antwerpen	BE	BETR801	pm25	6.5	µg/m³
2019-06-17 07:00:00+00:00	Antwerpen	BE	BETR801	pm25	18.5	µg/m³
2019-06-17 06:00:00+00:00	Antwerpen	BE	BETR801	pm25	16.0	µg/m³
2019-06-17 05:00:00+00:00	Antwerpen	BE	BETR801	pm25	7.5	µg/m³
…	…	…	…	…	…	…
2019-04-09 06:00:00+00:00	London	GB	London Westminster	no2		
2019-04-09 05:00:00+00:00	London	GB	London Westminster	no2		
2019-04-09 04:00:00+00:00	London	GB	London Westminster	no2		
2019-04-09 03:00:00+00:00	London	GB	London Westminster	no2		
2019-04-09 02:00:00+00:00	London	GB	London Westminster	no2		

```
2019-04-09 06:00:00+00:00   41.0  µg/m³
2019-04-09 05:00:00+00:00   41.0  µg/m³
2019-04-09 04:00:00+00:00   41.0  µg/m³
2019-04-09 03:00:00+00:00   67.0  µg/m³
2019-04-09 02:00:00+00:00   67.0  µg/m³

[5272 rows x 6 columns]
```

[25]:
```
air_quality.pivot_table(
    values="value", index="location", columns="parameter",aggfunc="mean")
```

[25]:
```
parameter                no2       pm25
location
BETR801             26.950920  23.169492
FR04014             29.374284        NaN
London Westminster  29.740050  13.443568
```

[26]:
```
air_quality.pivot_table(
    values="value",
    index="location",
    columns="parameter",
    aggfunc="mean",
    margins=True,
)
```

[26]:
```
parameter                no2       pm25        All
location
BETR801             26.950920  23.169492  24.982353
FR04014             29.374284        NaN  29.374284
London Westminster  29.740050  13.443568  21.491708
All                 29.430316  14.386849  24.222743
```

[27]:
```
air_quality.groupby(["parameter","location"]).mean()
```

[27]:
```
                                  value
parameter location
no2       BETR801             26.950920
          FR04014             29.374284
          London Westminster  29.740050
pm25      BETR801             23.169492
          London Westminster  13.443568
```

[28]:
```
no2_pivioted=no2.pivot(columns="location",values="value").reset_index()
```

[29]:
```
no2_pivioted.head()
```

[29]:
```
location                  date.utc  BETR801  FR04014  London Westminster
0         2019-04-09 01:00:00+00:00     22.5     24.4                 NaN
1         2019-04-09 02:00:00+00:00     53.5     27.4                67.0
2         2019-04-09 03:00:00+00:00     54.5     34.2                67.0
3         2019-04-09 04:00:00+00:00     34.5     48.5                41.0
4         2019-04-09 05:00:00+00:00     46.5     59.5                41.0
```

[33]:
```
no2=no2_pivioted.melt(id_vars="date.utc")
```

[31]:
```
no2.location.unique()
```

[31]:
```
array(['BETR801', 'FR04014', 'London Westminster'], dtype=object)
```

[36]:
```
no2=no2_pivioted.melt(
    id_vars="date.utc",
    value_vars=["BETR801","FR04014","London Westminster"],
    value_name="NO_2",
    var_name="id_location",
    )
```

[37]:
```
no2.head()
```

[37]:
```
                  date.utc id_location  NO_2
0 2019-04-09 01:00:00+00:00     BETR801  22.5
1 2019-04-09 02:00:00+00:00     BETR801  53.5
2 2019-04-09 03:00:00+00:00     BETR801  54.5
3 2019-04-09 04:00:00+00:00     BETR801  34.5
4 2019-04-09 05:00:00+00:00     BETR801  46.5
```

2 Page=47

[39]:
```
import pandas as pd
```

[40]:
```
air_quality_no2=pd.read_csv("air_quality_long.csv")
```

[41]:
```
air_quality_no2=air_quality_no2[["date.utc","location","parameter","value"]]
```

[42]:
```
air_quality_no2
```

[42]:
```
                       date.utc            location parameter  value
0     2019-06-18 06:00:00+00:00             BETR801      pm25   18.0
1     2019-06-17 08:00:00+00:00             BETR801      pm25    6.5
2     2019-06-17 07:00:00+00:00             BETR801      pm25   18.5
3     2019-06-17 06:00:00+00:00             BETR801      pm25   16.0
4     2019-06-17 05:00:00+00:00             BETR801      pm25    7.5
…                           …                   …       …     …
5267  2019-04-09 06:00:00+00:00  London Westminster       no2   41.0
```

```
5268  2019-04-09 05:00:00+00:00  London Westminster       no2   41.0
5269  2019-04-09 04:00:00+00:00  London Westminster       no2   41.0
5270  2019-04-09 03:00:00+00:00  London Westminster       no2   67.0
5271  2019-04-09 02:00:00+00:00  London Westminster       no2   67.0

[5272 rows x 4 columns]
```

[43]:
```
air_quality_no2.head()
```

[43]:
```
                   date.utc location parameter  value
0  2019-06-18 06:00:00+00:00  BETR801      pm25   18.0
1  2019-06-17 08:00:00+00:00  BETR801      pm25    6.5
2  2019-06-17 07:00:00+00:00  BETR801      pm25   18.5
3  2019-06-17 06:00:00+00:00  BETR801      pm25   16.0
4  2019-06-17 05:00:00+00:00  BETR801      pm25    7.5
```

[44]:
```
air_quality_pm25=pd.read_csv("air_quality_pm25_long.csv")
```

[45]:
```
air_quality_pm25=air_quality_pm25[["date.utc","location","parameter","value"]]
```

[46]:
```
air_quality_pm25.head()
```

[46]:
```
                   date.utc location parameter  value
0  2019-06-18 06:00:00+00:00  BETR801      pm25   18.0
1  2019-06-17 08:00:00+00:00  BETR801      pm25    6.5
2  2019-06-17 07:00:00+00:00  BETR801      pm25   18.5
3  2019-06-17 06:00:00+00:00  BETR801      pm25   16.0
4  2019-06-17 05:00:00+00:00  BETR801      pm25    7.5
```

[47]:
```
air_quality=pd.concat([air_quality_pm25,air_quality_no2],axis=0)
```

[48]:
```
air_quality.head()
```

[48]:
```
                   date.utc location parameter  value
0  2019-06-18 06:00:00+00:00  BETR801      pm25   18.0
1  2019-06-17 08:00:00+00:00  BETR801      pm25    6.5
2  2019-06-17 07:00:00+00:00  BETR801      pm25   18.5
3  2019-06-17 06:00:00+00:00  BETR801      pm25   16.0
4  2019-06-17 05:00:00+00:00  BETR801      pm25    7.5
```

[49]:
```
print('shape of the ``air_quality_pm25`` table: ',air_quality_pm25.shape)
print('shape of the ``air_quality_no2`` table: ', air_quality_no2.shape)
print('shape of the resulting ``air_quality`` table: ',air_quality.shape)
```

```
shape of the ``air_quality_pm25`` table:  (1110, 4)
shape of the ``air_quality_no2`` table:  (5272, 4)
shape of the resulting ``air_quality`` table:  (6382, 4)
```

[50]:
```
air_quality=air_quality.sort_values("date.utc")
```

[51]:
```
air_quality
```

[51]:
```
                       date.utc            location parameter  value
3500  2019-04-09 01:00:00+00:00             FR04014       no2   24.4
176   2019-04-09 01:00:00+00:00             BETR801      pm25   76.0
3663  2019-04-09 01:00:00+00:00             BETR801       no2   22.5
5271  2019-04-09 02:00:00+00:00  London Westminster       no2   67.0
1824  2019-04-09 02:00:00+00:00  London Westminster      pm25   42.0
…                           …                   …       …     …
1826  2019-06-20 23:00:00+00:00             FR04014       no2   21.8
178   2019-06-20 23:00:00+00:00  London Westminster      pm25    7.0
1825  2019-06-21 00:00:00+00:00             FR04014       no2   20.0
177   2019-06-21 00:00:00+00:00  London Westminster      pm25    7.0
101   2019-06-21 00:00:00+00:00  London Westminster      pm25    7.0

[6382 rows x 4 columns]
```

[52]:
```
air_quality=pd.concat([air_quality_pm25,air_quality_no2], keys=["PM25","NO2"])
```

[53]:
```
air_quality.head()
```

[53]:
```
                         date.utc location parameter  value
PM25 0  2019-06-18 06:00:00+00:00  BETR801      pm25   18.0
     1  2019-06-17 08:00:00+00:00  BETR801      pm25    6.5
     2  2019-06-17 07:00:00+00:00  BETR801      pm25   18.5
     3  2019-06-17 06:00:00+00:00  BETR801      pm25   16.0
     4  2019-06-17 05:00:00+00:00  BETR801      pm25    7.5
```

[54]:
```
stations_coord=pd.read_csv("air_quality_stations.csv")
```

[55]:
```
stations_coord.head()
```

[55]:
```
  location  coordinates.latitude  coordinates.longitude
0  BELAL01              51.23619                4.38522
1  BELHB23              51.17030                4.34100
2  BELLD01              51.10998                5.00486
3  BELLD02              51.12038                5.02155
4  BELR833              51.32766                4.36226
```

[56]:
```
air_quality=pd.merge(air_quality,stations_coord,how="left",on="location")
```

[57]:
```
air_quality
```

[57]:
```
                       date.utc            location parameter  value  \
0     2019-06-18 06:00:00+00:00             BETR801      pm25   18.0
1     2019-06-17 08:00:00+00:00             BETR801      pm25    6.5
```

```
2     2019-06-17 07:00:00+00:00             BETR801      pm25   18.5
3     2019-06-17 06:00:00+00:00             BETR801      pm25   16.0
4     2019-06-17 05:00:00+00:00             BETR801      pm25    7.5
…                           …                   …       …     …
8053  2019-04-09 06:00:00+00:00  London Westminster       no2   41.0
8054  2019-04-09 05:00:00+00:00  London Westminster       no2   41.0
8055  2019-04-09 04:00:00+00:00  London Westminster       no2   41.0
8056  2019-04-09 03:00:00+00:00  London Westminster       no2   67.0
8057  2019-04-09 02:00:00+00:00  London Westminster       no2   67.0

      coordinates.latitude  coordinates.longitude
0                 51.20966               4.43182
1                 51.20966               4.43182
2                 51.20966               4.43182
3                 51.20966               4.43182
4                 51.20966               4.43182
…                    …                   …
8053              51.49467              -0.13193
8054              51.49467              -0.13193
8055              51.49467              -0.13193
8056              51.49467              -0.13193
8057              51.49467              -0.13193

[8058 rows x 6 columns]
```

[58]:
```
air_quality_parameters=pd.read_csv("air_quality_parameters.csv")
```

[59]:
```
air_quality_parameters
```

[59]:
```
     id                                        description   name
0    bc                                        Black Carbon     BC
1    co                                      Carbon Monoxide     CO
2   no2                                     Nitrogen Dioxide    NO2
3    o3                                                Ozone     O3
4  pm10  Particulate matter less than 10 micrometers in…   PM10
5  pm25  Particulate matter less than 2.5 micrometers i…  PM2.5
6   so2                                       Sulfur Dioxide    SO2
```

[60]:
```
air_quality=pd.
↪merge(air_quality,air_quality_parameters,how='left',left_on='parameter',right_on='id')
```

[61]:
```
air_quality
```

[61]:
```
                    date.utc            location parameter  value  \
0     2019-06-18 06:00:00+00:00             BETR801      pm25   18.0
1     2019-06-17 08:00:00+00:00             BETR801      pm25    6.5
2     2019-06-17 07:00:00+00:00             BETR801      pm25   18.5
```

```
3     2019-06-17 06:00:00+00:00              BETR801      pm25   16.0
4     2019-06-17 05:00:00+00:00              BETR801      pm25    7.5
…                           …                    …       …     …
8053  2019-04-09 06:00:00+00:00  London Westminster       no2   41.0
8054  2019-04-09 05:00:00+00:00  London Westminster       no2   41.0
8055  2019-04-09 04:00:00+00:00  London Westminster       no2   41.0
8056  2019-04-09 03:00:00+00:00  London Westminster       no2   67.0
8057  2019-04-09 02:00:00+00:00  London Westminster       no2   67.0

      coordinates.latitude  coordinates.longitude    id  \
0                 51.20966               4.43182  pm25
1                 51.20966               4.43182  pm25
2                 51.20966               4.43182  pm25
3                 51.20966               4.43182  pm25
4                 51.20966               4.43182  pm25
…                    …                     …   …
8053              51.49467              -0.13193   no2
8054              51.49467              -0.13193   no2
8055              51.49467              -0.13193   no2
8056              51.49467              -0.13193   no2
8057              51.49467              -0.13193   no2

                                          description   name
0     Particulate matter less than 2.5 micrometers i…  PM2.5
1     Particulate matter less than 2.5 micrometers i…  PM2.5
2     Particulate matter less than 2.5 micrometers i…  PM2.5
3     Particulate matter less than 2.5 micrometers i…  PM2.5
4     Particulate matter less than 2.5 micrometers i…  PM2.5
…                                                  …     …
8053                                 Nitrogen Dioxide    NO2
8054                                 Nitrogen Dioxide    NO2
8055                                 Nitrogen Dioxide    NO2
8056                                 Nitrogen Dioxide    NO2
8057                                 Nitrogen Dioxide    NO2

[8058 rows x 9 columns]
```

[62]:
```
import pandas as pd
```

[63]:
```
import matplotlib.pylab as plt
```

[64]:
```
air_quality=pd.read_csv("air_quality_no2_long.csv")
```

[65]:
```
air_quality
```

[65]:
```
        city country                   date.utc            location parameter  \
0      Paris      FR  2019-06-21 00:00:00+00:00             FR04014       no2
```

```
1      Paris      FR  2019-06-20 23:00:00+00:00             FR04014       no2
2      Paris      FR  2019-06-20 22:00:00+00:00             FR04014       no2
3      Paris      FR  2019-06-20 21:00:00+00:00             FR04014       no2
4      Paris      FR  2019-06-20 20:00:00+00:00             FR04014       no2
…      …      …                          …                 …       …
2063  London      GB  2019-05-07 06:00:00+00:00  London Westminster       no2
2064  London      GB  2019-05-07 04:00:00+00:00  London Westminster       no2
2065  London      GB  2019-05-07 03:00:00+00:00  London Westminster       no2
2066  London      GB  2019-05-07 02:00:00+00:00  London Westminster       no2
2067  London      GB  2019-05-07 01:00:00+00:00  London Westminster       no2

      value   unit
0      20.0  µg/m³
1      21.8  µg/m³
2      26.5  µg/m³
3      24.9  µg/m³
4      21.4  µg/m³
…      …     …
2063   26.0  µg/m³
2064   16.0  µg/m³
2065   19.0  µg/m³
2066   19.0  µg/m³
2067   23.0  µg/m³

[2068 rows x 7 columns]
```

[66]:
```
air_quality=air_quality.rename(columns={"date.utc":"datetime"})
```

[67]:
```
air_quality.head()
```

[67]:
```
    city country                  datetime location parameter  value   unit
0  Paris      FR  2019-06-21 00:00:00+00:00  FR04014       no2   20.0  µg/m³
1  Paris      FR  2019-06-20 23:00:00+00:00  FR04014       no2   21.8  µg/m³
2  Paris      FR  2019-06-20 22:00:00+00:00  FR04014       no2   26.5  µg/m³
3  Paris      FR  2019-06-20 21:00:00+00:00  FR04014       no2   24.9  µg/m³
4  Paris      FR  2019-06-20 20:00:00+00:00  FR04014       no2   21.4  µg/m³
```