In [1]:

```
import pandas as pd
import numpy as np
from datetime import datetime
import matplotlib.pyplot as plt
%matplotlib inline
```

In [2]:

```
euro = pd.read_csv('euro-daily-hist_1999_2022.csv')
```

In [3]:

```
euro.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6068 entries, 0 to 6067
Data columns (total 41 columns):
 #   Column                    Non-Null Count  Dtype  
---  ------                    --------------  -----  
 0   Period\Unit:              6068 non-null   object 
 1   [Australian dollar ]      6068 non-null   object 
 2   [Bulgarian lev ]          5666 non-null   object 
 3   [Brazilian real ]         5800 non-null   object 
 4   [Canadian dollar ]        6068 non-null   object 
 5   [Swiss franc ]            6068 non-null   object 
 6   [Chinese yuan renminbi ]  5800 non-null   object 
 7   [Cypriot pound ]          2346 non-null   object 
 8   [Czech koruna ]           6068 non-null   object 
 9   [Danish krone ]           6068 non-null   object 
 10  [Estonian kroon ]         3130 non-null   object 
 11  [UK pound sterling ]      6068 non-null   object 
 12  [Greek drachma ]          520 non-null    object 
 13  [Hong Kong dollar ]       6068 non-null   object 
 14  [Croatian kuna ]          5800 non-null   object 
 15  [Hungarian forint ]       6068 non-null   object 
 16  [Indonesian rupiah ]      6068 non-null   object 
 17  [Israeli shekel ]         5800 non-null   object 
 18  [Indian rupee ]           5800 non-null   object 
 19  [Iceland krona ]          3661 non-null   float64
 20  [Japanese yen ]           6068 non-null   object 
 21  [Korean won ]             6068 non-null   object 
 22  [Lithuanian litas ]       4159 non-null   object 
 23  [Latvian lats ]           3904 non-null   object 
 24  [Maltese lira ]           2346 non-null   object 
 25  [Mexican peso ]           6068 non-null   object 
 26  [Malaysian ringgit ]      6068 non-null   object 
 27  [Norwegian krone ]        6068 non-null   object 
 28  [New Zealand dollar ]     6068 non-null   object 
 29  [Philippine peso ]        6068 non-null   object 
 30  [Polish zloty ]           6068 non-null   object 
 31  [Romanian leu ]           6006 non-null   float64
 32  [Russian rouble ]         5994 non-null   object 
 33  [Swedish krona ]          6068 non-null   object 
 34  [Singapore dollar ]       6068 non-null   object 
 35  [Slovenian tolar ]        2085 non-null   object 
 36  [Slovak koruna ]          2608 non-null   object 
 37  [Thai baht ]              6068 non-null   object 
 38  [Turkish lira ]           6006 non-null   float64
 39  [US dollar ]              6068 non-null   object 
 40  [South African rand ]     6068 non-null   object 
dtypes: float64(3), object(38)
memory usage: 1.9+ MB
```

In this dataset, we find 41 columns, the first being the conversion date and the other 40 referring to countries and the euro's value converted to the local currency on that date.

Most of the information is in text form.

The dataset currently has 6068 rows, but many columns have null values.

In [4]:

```
euro
```

Out[4]:

	Period\Unit:	[Australian dollar]	[Bulgarian lev]	[Brazilian real]	[Canadian dollar]	[Swiss franc]	[Chinese yuan renminbi]	[Cypriot pound]
0	2022-06-15	1.5051	1.9558	5.3164	1.3498	1.0435	7.0013	NaN
1	2022-06-14	1.5174	1.9558	5.3329	1.3522	1.0394	7.0417	NaN
2	2022-06-13	1.4998	1.9558	5.2785	1.3435	1.0375	7.0434	NaN
3	2022-06-10	1.4845	1.9558	5.1718	1.3484	1.0404	7.0868	NaN
4	2022-06-09	1.4985	1.9558	5.2506	1.3506	1.0495	7.1722	NaN
...	...	...	...	...	...	...	...	...
6063	1999-01-08	1.8406	NaN	NaN	1.7643	1.6138	NaN	0.58187
6064	1999-01-07	1.8474	NaN	NaN	1.7602	1.6165	NaN	0.58187
6065	1999-01-06	1.8820	NaN	NaN	1.7711	1.6116	NaN	0.58200
6066	1999-01-05	1.8944	NaN	NaN	1.7965	1.6123	NaN	0.58230
6067	1999-01-04	1.9100	NaN	NaN	1.8004	1.6168	NaN	0.58231

6068 rows × 41 columns

As mentioned, the dataset has 6068 entries, and they are arranged in descending order of time. To make the work more accessible, we will change the name of the columns **"period\Unit"** and **"[Russian rouble]"** to **"Time"** and **"Rouble"**respectively. Also, the "Time" column will be converted to DateTime format and sorted in ascending order.

In [5]:

```
euro.rename(columns={'[Russian rouble ]':'rouble','Period\\Unit:': 'Time'}, inplace=Tru
e)
euro['Time'] = pd.to_datetime(euro['Time'])
euro.sort_values('Time', inplace=True)
euro.reset_index(drop=True, inplace=True)
```

In [6]:

```
#euro_to_dollar = euro[['Time', 'US_dollar']]
euro_to_rouble = euro[['Time','rouble']]
#euro_to_dollar['rouble'].value_counts()
euro_to_rouble['rouble'].value_counts()
```

Out[6]:

```
-          62
35.2250     4
39.6750     4
40.6500     4
40.5950     4
           ..
78.2063     1
83.6856     1
34.9360     1
43.1540     1
38.6550     1
Name: rouble, Length: 5705, dtype: int64
```

In addition to the null values, in the data in the "Rouble" column are 62 entries without any value, so that these values will be removed from the dataset along with the null entries.

In [7]:

```
euro_to_rouble = euro_to_rouble[euro_to_rouble['rouble'] != '-']
euro_to_rouble['rouble'] = euro_to_rouble['rouble'].astype(float)
```

In [8]:

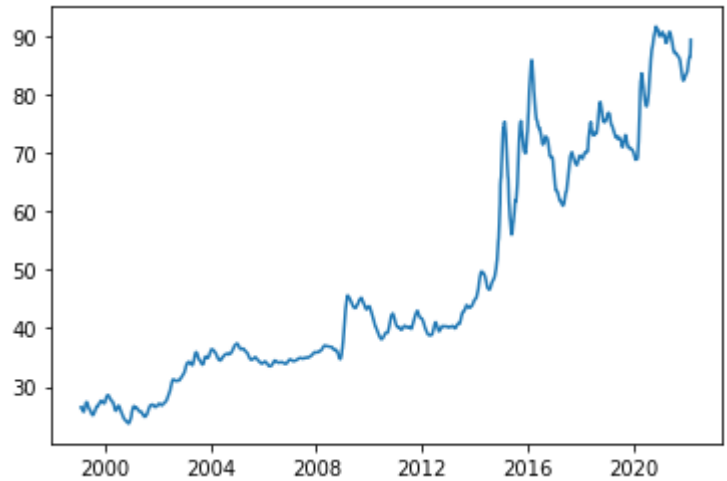
```
euro_to_rouble = euro_to_rouble.dropna()
```

In [9]:

```
euro_to_rouble['rolling_mean'] = euro_to_rouble['rouble'].rolling(30).mean()
```

In [10]:

```
plt.plot(euro_to_rouble['Time'], euro_to_rouble['rolling_mean'])
plt.show()
```



It is possible to notice an increase occurring after 2014. Therefore, an analysis of the curve before and after 2014 is performed.

In [11]:

```
euro_to_rouble['Year'] = euro_to_rouble['Time'].dt.year
```

In [12]:

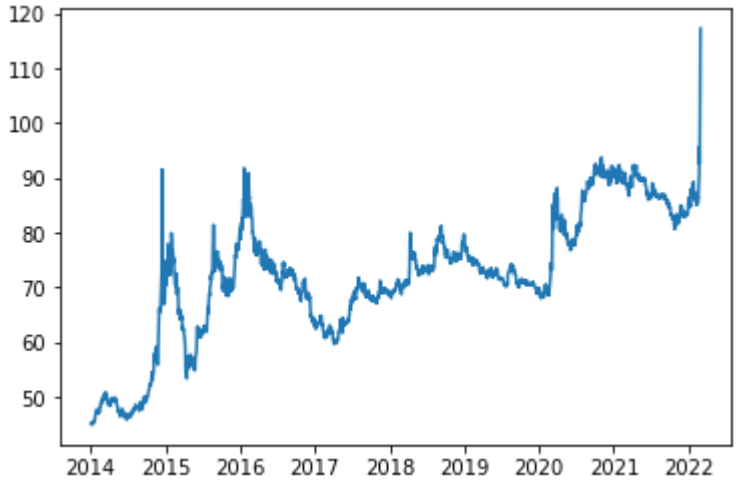
```
b2014 = euro_to_rouble[euro_to_rouble['Year']<2014.0]
a2014 = euro_to_rouble[euro_to_rouble['Year']>=2014.0]
```

In [13]:

```
plt.plot(b2014['Time'], b2014['rolling_mean'])
plt.show()
```

In [14]:

```
plt.plot(a2014['Time'], a2014['rouble'])
plt.show()
```



Through research, it was possible to confirm that the variation in the Russian exchange rate is linked to international conflicts and how the country relates to other nations. Therefore, the final graph was decided to use the exchange rate variation over all the years.

In [15]:

```
# Creating a mask to plot the Russian financial crisis 2014-2016
A = euro_to_rouble['Time']>='2014-03-01'
B = euro_to_rouble['Time']<='2016-12-01'

fig, ax = plt.subplots(1,1, figsize=(16,8))
ax.plot(euro_to_rouble[~A]['Time'], euro_to_rouble[~A]['rouble'], color='#6495ED', alph
a=0.8, zorder=2)
ax.plot(euro_to_rouble[A&B]['Time'], euro_to_rouble[A&B]['rouble'], color='#DC143C',alp
ha=0.8, zorder=2)
ax.plot(euro_to_rouble[~B]['Time'], euro_to_rouble[~B]['rouble'], color='#6495ED', alph
a=0.8, zorder=2)

for spine in ax.spines.values():
    spine.set_visible(False)

ax.set_facecolor('#F8F8FF')
ax.grid(color='#CCCCCC', linestyle='solid', lw = 1.2, axis='y')


ax.text(x=733850,y=9.5,s='Year',size=14)
ax.text(x=728910,y=58,s='Euro to Rouble',size=14, rotation = 'vertical')

ax.text(x=730900,y=130,s='Impact of international conflicts on the Russian currency',si
ze=18, weight ='bold')
ax.text(x=730750,y=125,s='An analysis of the exchange rate variation between Euro and R
ouble in the last 23 years',size=14)


# The Great Recession in Russia
ax.axvline(x=datetime.strptime('2008-10-10', '%Y-%m-%d'), ymin=0.27, ymax=0.475, lw=1.2
, color='#ED9121', zorder=3)
ax.axhline(60, xmin=0.24, xmax=0.428, lw=1.2, color='#ED9121', zorder=3)
ax.scatter(731590,60,s=50, facecolors='#ED9121', edgecolors='#ED9121', zorder=3)
ax.text(x=730750,y=56.5,s='The Great Recession in Russia', weight='bold')
ax.text(x=730050,y=47,s='Crisis during 2008–2009 in the Russian financial markets as we
ll as an\n economic recession that was compounded by political fears after\n'+40*' '+'t
he war with Georgia', size ='small')

# Crimea annexation
ax.axvline(x=datetime.strptime('2014-02-20', '%Y-%m-%d'), ymin=0.395, ymax=0.575, lw=1.
2, color='#ED9121', zorder=3)
ax.axhline(72, xmin=0.57, xmax=0.638, lw=1.2, color='#ED9121', zorder=3)
ax.scatter(734650,72,s=50, facecolors='#ED9121', edgecolors='#ED9121', zorder=3)
ax.text(x=734350,y=68,s='02/20/2014', weight='bold')
ax.text(x=734150,y=65.5,s='Crimea Annexation')

# War in Donbas
#Begin of war in Donbas
ax.axvline(x=datetime.strptime('2014-04-12', '%Y-%m-%d'), ymin=0.30, ymax=0.38, lw=1.2,
color='m', zorder=3)
ax.scatter(datetime.strptime('2014-04-12', '%Y-%m-%d'),38.9,s=40, facecolors='m', edgec
olors='m', zorder=3)
ax.text(x=735000,y=35,s='04/12/2014', weight='bold')
ax.text(x=734830,y=32,s='Donbas War begins')


#End of war in Donbas
ax.axvline(x=datetime.strptime('2015-02-15', '%Y-%m-%d'), ymin=0.35, ymax=0.55, lw=1.2,
```

```
color='m', zorder=3)
ax.axhline(45, xmin=0.677, xmax=0.75, lw=1.2, color='m', zorder=3)
ax.scatter(736340,45,s=40, facecolors='m', edgecolors='m', zorder=3)
ax.text(x=736030,y=41,s='02/15/2015', weight='bold')
ax.text(x=735930,y=38,s='Donbas War ends')

# Russian financial crisis 2014-2016
ax.text(x=735130,y=96,s='Russian Financial Crisis', weight='bold', backgroundcolor='#DC
143C', color='#F8F8FF')
ax.text(x=733410,y=101,s='The financial crisis in Russia in 2014–2016 was the result of
the sharp devaluation of the Russian ruble\n           beginning in the  second half of
2014. One of the major sources of the crisis is the result of\n'+45*' '+'international
 economic sanctions imposed on Russia', size='small')

# Ukraine invasion
ax.axvline(x=datetime.strptime('2022-02-15', '%Y-%m-%d'), ymin=0.60, ymax=0.69, lw=1.2,
color='#ED9121', zorder=3) #2022-02-24
ax.scatter(datetime.strptime('2022-02-15', '%Y-%m-%d'),74.5,s=40, facecolors='#ED9121',
edgecolors='#ED9121', zorder=3)
ax.text(x=737870,y=70,s='02/24/2022', weight='bold')
ax.text(x=737750,y=67,s='Ukraine Invasion')


# Legend
ax.axhline(9, xmin=0, xmax=1, lw=1.2, color='#F8F8FF')
ax.text(x=729395,y=4,
        s='©Yuri Alves' + 163*' ' + 'Source: jia.sipa.columbia.edu',
        color = '#f0f0f0', #f0f0f0
        backgroundcolor = '#4d4d4d',
        size=12)

# Grid adjust

ax.set_xticklabels([])
year = ['2000', '2004', '2008', '2012', '2016', '2020']
pos = [730120,731580,733040,734510,735970,737430]

for i in range(6):
    ax.axvline(x=pos[i], ymin=0.1, ymax=1, lw=1.2, color='#CCCCCC', zorder=1)
    ax.text(x=pos[i]-130, y=12.5, s=year[i])

plt.savefig('Russian.png', dpi=fig.dpi)
plt.show()
```


Impact of international conflicts on the Russian currency
An analysis of the exchange rate variation between Euro and Rouble in the last 23 years
Euro to Rouble
Year
The financial crisis in Russia in 2014–2016 was the result of the sharp devaluation of the Russian ruble beginning in the second half of 2014. One of the major sources of the crisis is the result of international economic sanctions imposed on Russia
Russian Financial Crisis
The Great Recession in Russia
Crisis during 2008–2009 in the Russian financial markets as well as an economic recession that was compounded by political fears after the war with Georgia
02/20/2014
Crimea Annexation
04/12/2014
Donbas War begins
02/15/2015
Donbas War ends
02/24/2022
Ukraine Invasion
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