COVID-19 Project

May 27, 2020

1 COVID-19

We are given two DataFrames that provides information about COVID-19. Our task is to visualize this data to understand it better. Let's import all required Data-sets.

[13]:

```
import pandas as pd
import itertools
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from matplotlib.ticker import NullFormatter
import matplotlib.ticker as ticker
from sklearn import preprocessing
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import jaccard_similarity_score
from sklearn import metrics
import folium
import geopandas as gpd
import json
```

1.1 Data Inputting and Data Cleaning.

[14]:

```
df1=pd.read_csv('COVID-19.csv')
df2=pd.read_csv('2COVID-19.csv')
df1.head()
```

[14]:

```
  Province/State Country/Region          Last Update  Confirmed  Deaths  \
0          Hubei          China  2020-03-17T11:53:10      67799    3111
1            NaN          Italy  2020-03-17T18:33:02      31506    2503
2            NaN           Iran  2020-03-17T15:13:09      16169     988
3            NaN          Spain  2020-03-17T20:53:02      11748     533
4            NaN        Germany  2020-03-17T18:53:02       9257      24

   Recovered  Latitude  Longitude
0      56003   30.9756   112.2707
1       2941   41.8719    12.5674
```

```
2        5389   32.4279    53.6880
3        1028   40.4637    -3.7492
4          67   51.1657    10.4515
```

```
[15]: df2.head()
```

```
[15]:          Entity Code  Day since outbreak  Total confirmed cases of COVID-19
      0  Afghanistan  AFG                  35                                  1
      1  Afghanistan  AFG                  36                                  1
      2  Afghanistan  AFG                  37                                  1
      3  Afghanistan  AFG                  38                                  1
      4  Afghanistan  AFG                  39                                  1
```

It can be seen **df1** can be modified to make it more workable. Particularly, Variable **Last Update** will be changed. There are some countries for which data about provinces have also been given, these countires will be seperated from other ones.

```
[16]: df1['Last Update'] = pd.to_datetime(df1['Last Update'])

      # a DataFrame that has countries for which provincial information is provided.
      provinces_c = df1.dropna()
      provinces_c.reset_index(inplace=True)
      provinces_c.drop('index',axis=1,inplace=True)

      # a DataFrame that only has countries for which provincial information is not␣
       ↪provided.
      countries_c = df1[pd.isnull(df1['Province/State'])]
      countries_c.drop('Province/State', axis=1, inplace=True)
      countries_c.head()
```

```
[16]:   Country/Region         Last Update  Confirmed  Deaths  Recovered  Latitude  \
      1           Italy 2020-03-17 18:33:02      31506    2503       2941   41.8719
      2            Iran 2020-03-17 15:13:09      16169     988       5389   32.4279
      3           Spain 2020-03-17 20:53:02      11748     533       1028   40.4637
      4         Germany 2020-03-17 18:53:02       9257      24         67   51.1657
      5    Korea, South 2020-03-17 10:33:03       8320      81       1407   35.9078

         Longitude
      1    12.5674
      2    53.6880
      3    -3.7492
      4    10.4515
      5   127.7669
```

```
[5]:  provinces_c.head()
```

[5]:

```
  Province/State  Country/Region          Last Update  Confirmed  Deaths  \
0          Hubei           China 2020-03-17 11:53:10      67799    3111
1         France          France 2020-03-17 19:13:08       7652     148
2 United Kingdom  United Kingdom 2020-03-17 15:13:09       1950      55
3       New York              US 2020-03-17 22:53:03       1706      13
4    Netherlands     Netherlands 2020-03-17 15:13:11       1705      43

  Recovered  Latitude  Longitude
0     56003   30.9756   112.2707
1        12   46.2276     2.2137
2        52   55.3781    -3.4360
3         0   42.1657   -74.9481
4         2   52.1326     5.2913
```

Now that we have seperated our data into 2, the data from provinces will be summed up to get information about its country.

[6]:

```
df6=countries_c.drop('Last Update', axis=1)
df6.drop('Latitude', axis=1, inplace=True)
df6.drop('Longitude', axis=1, inplace=True)
df6=df6.groupby('Country/
 ↪Region',as_index=False)['Confirmed','Deaths','Recovered'].sum()
df5=provinces_c.groupby('Country/
 ↪Region',as_index=False)['Confirmed','Deaths','Recovered'].sum()
frames = [df5, df6]
countries_total = pd.concat(frames)
countries_total=countries_total.sort_values(by=['Confirmed'], ascending=False)
countries_total.head()
```

[6]:

```
    Country/Region  Confirmed  Deaths  Recovered
2            China      81058    3230      68798
67           Italy      31506    2503       2941
63            Iran      16169     988       5389
128          Spain      11748     533       1028
47         Germany       9257      24         67
```

1.2 VISUALIZATION

1.2.1 Which countries have the most number of cases in March?

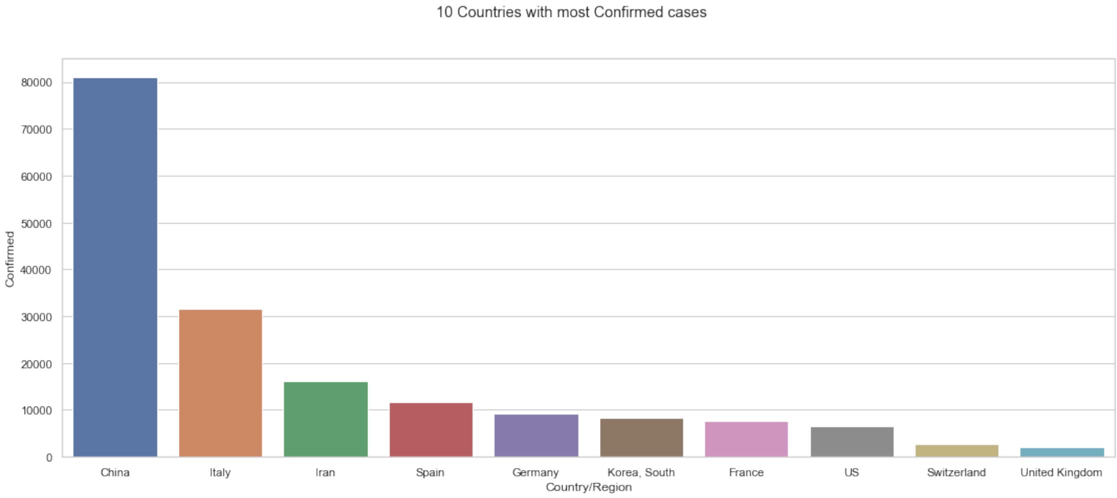
Let's make a bar chart to see 10 countries which have most confirmed cases.

[7]:

```
countries_total_sub = countries_total[:10]
plt.figure(figsize=(18, 7))
sns.set(style="whitegrid")
sns.barplot(x=countries_total_sub['Country/
 ↪Region'],y=countries_total_sub['Confirmed'])
plt.suptitle('10 Countries with most Confirmed cases')
```

```
#sns.set(style="whitegrid")
#sns.barplot(x=countries_total['Country/Region'],y=countries_total['Confirmed'])
#plt.title('10 Countries with most Confirmed cases')
```

```
[7]: Text(0.5, 0.98, '10 Countries with most Confirmed cases')
```

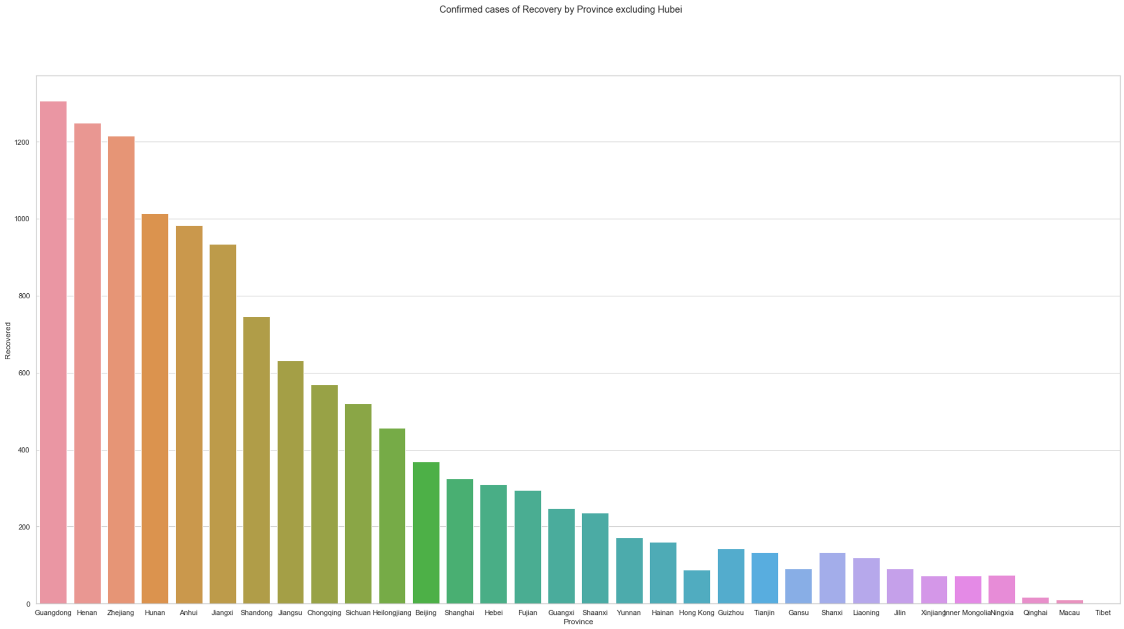


1.2.2 How many Infected patients have recovered in Different Provinces Of China?

I have excluded the province **Hubei** from the graph because their recovery amount is the highest, more than **60000**, creating a very unpleasent visualization.

```
[8]: Chine_dic={'Province':[],'Recovered':[]}
     for item in range(len(provinces_c['Country/Region'])):
         if provinces_c['Country/Region'][item] == 'China':
             prov = provinces_c['Province/State'][item]
             recov = provinces_c['Recovered'][item]
             Chine_dic['Province'].append(prov)
             Chine_dic['Recovered'].append(recov)

     #DataFrame Consisting of China's Provinces and Recovery amount.
     Chine_prov = pd.DataFrame(Chine_dic)

     #Removing province Hubei
     Chine_prov_1 = Chine_prov[1:]
     #Chine_prov_1 = Chine_prov[:]#Uncomment this and comment out the line abouve to␣
      ↪include Hubei

     #Plotting.
     plt.figure(figsize=(30, 15))
     sns.set(style="whitegrid")
     sns.barplot(x=Chine_prov_1['Province'],y=Chine_prov_1['Recovered'])
     plt.suptitle('Confirmed cases of Recovery by Province excluding Hubei')
```

```
[8]: Text(0.5, 0.98, 'Confirmed cases of Recovery by Province excluding Hubei')
```



We can see after Hubei, **Guangdong** has highest amount of recovery.

1.2.3 How has the number of patients infected with COVID-19 increased over time in the UK and other countries.

Lets create a DataFrame for UK and 9 other countries with highest confirmed cases.

```
[9]: # Cases by day for UK.
UK_dic={'Days Since Outbreak':[],'Cases of COVID-19':[]}
for item in range(len(df2['Entity'])):
    if df2['Entity'][item] == 'United Kingdom':
        Days_Since_Outbreak = df2['Day since outbreak'][item]
        Cases = df2['Total confirmed cases of COVID-19'][item]
        UK_dic['Days Since Outbreak'].append(Days_Since_Outbreak)
        UK_dic['Cases of COVID-19'].append(Cases)
df_UK = pd.DataFrame(UK_dic)

# Cases by day for US.
US_dic={'Days Since Outbreak':[],'Cases of COVID-19':[]}
for item in range(len(df2['Entity'])):
    if df2['Entity'][item] == 'United States':
        Days_Since_Outbreak = df2['Day since outbreak'][item]
        Cases = df2['Total confirmed cases of COVID-19'][item]
        US_dic['Days Since Outbreak'].append(Days_Since_Outbreak)
        US_dic['Cases of COVID-19'].append(Cases)
df_US = pd.DataFrame(US_dic)

# Cases by day for Iran.
Iran_dic={'Days Since Outbreak':[],'Cases of COVID-19':[]}
for item in range(len(df2['Entity'])):
    if df2['Entity'][item] == 'Iran':
        Days_Since_Outbreak = df2['Day since outbreak'][item]
        Cases = df2['Total confirmed cases of COVID-19'][item]
        Iran_dic['Days Since Outbreak'].append(Days_Since_Outbreak)
        Iran_dic['Cases of COVID-19'].append(Cases)
df_Iran = pd.DataFrame(Iran_dic)

# Cases by day for China.
Chine_dic={'Days Since Outbreak':[],'Cases of COVID-19':[]}
for item in range(len(df2['Entity'])):
    if df2['Entity'][item] == 'China':
        Days_Since_Outbreak = df2['Day since outbreak'][item]
        Cases = df2['Total confirmed cases of COVID-19'][item]
        Chine_dic['Days Since Outbreak'].append(Days_Since_Outbreak)
        Chine_dic['Cases of COVID-19'].append(Cases)
df_China = pd.DataFrame(Chine_dic)

# Cases by day for Italy.
Italy_dic={'Days Since Outbreak':[],'Cases of COVID-19':[]}
for item in range(len(df2['Entity'])):
    if df2['Entity'][item] == 'Italy':
        Days_Since_Outbreak = df2['Day since outbreak'][item]
        Cases = df2['Total confirmed cases of COVID-19'][item]
        Italy_dic['Days Since Outbreak'].append(Days_Since_Outbreak)
        Italy_dic['Cases of COVID-19'].append(Cases)
df_Italy = pd.DataFrame(Italy_dic)

# Cases by day for Spain.
Spain_dic={'Days Since Outbreak':[],'Cases of COVID-19':[]}
for item in range(len(df2['Entity'])):
    if df2['Entity'][item] == 'Spain':
        Days_Since_Outbreak = df2['Day since outbreak'][item]
        Cases = df2['Total confirmed cases of COVID-19'][item]
        Spain_dic['Days Since Outbreak'].append(Days_Since_Outbreak)
        Spain_dic['Cases of COVID-19'].append(Cases)
df_Spain = pd.DataFrame(Spain_dic)

# Cases by day for Germany.
Germany_dic={'Days Since Outbreak':[],'Cases of COVID-19':[]}
```

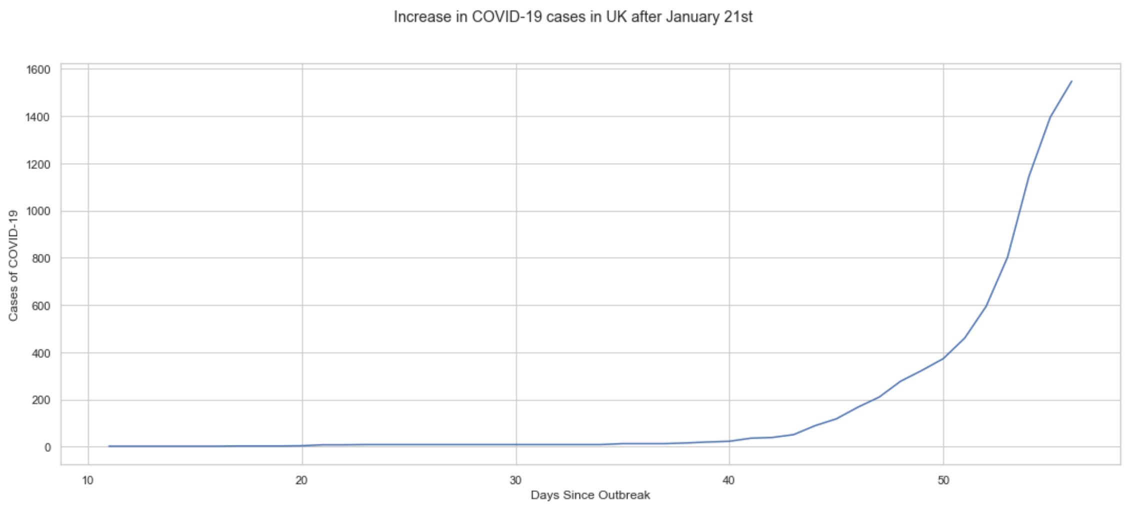
```
for item in range(len(df2['Entity'])):
    if df2['Entity'][item] == 'Germany':
        Days_Since_Outbreak = df2['Day since outbreak'][item]
        Cases = df2['Total confirmed cases of COVID-19'][item]
        Germany_dic['Days Since Outbreak'].append(Days_Since_Outbreak)
        Germany_dic['Cases of COVID-19'].append(Cases)
df_Germany = pd.DataFrame(Germany_dic)

# Cases by day for Sout_Korea.
South_Korea_dic={'Days Since Outbreak':[],'Cases of COVID-19':[]}
for item in range(len(df2['Entity'])):
    if df2['Entity'][item] == 'South Korea':
        Days_Since_Outbreak = df2['Day since outbreak'][item]
        Cases = df2['Total confirmed cases of COVID-19'][item]
        South_Korea_dic['Days Since Outbreak'].append(Days_Since_Outbreak)
        South_Korea_dic['Cases of COVID-19'].append(Cases)
df_South_Korea = pd.DataFrame(South_Korea_dic)

# Cases by day for France.
France_dic={'Days Since Outbreak':[],'Cases of COVID-19':[]}
for item in range(len(df2['Entity'])):
    if df2['Entity'][item] == 'France':
        Days_Since_Outbreak = df2['Day since outbreak'][item]
        Cases = df2['Total confirmed cases of COVID-19'][item]
        France_dic['Days Since Outbreak'].append(Days_Since_Outbreak)
        France_dic['Cases of COVID-19'].append(Cases)
df_France = pd.DataFrame(France_dic)

# Cases by day for Switzerland.
Switzerland_dic={'Days Since Outbreak':[],'Cases of COVID-19':[]}
for item in range(len(df2['Entity'])):
    if df2['Entity'][item] == 'Switzerland':
        Days_Since_Outbreak = df2['Day since outbreak'][item]
        Cases = df2['Total confirmed cases of COVID-19'][item]
        Switzerland_dic['Days Since Outbreak'].append(Days_Since_Outbreak)
        Switzerland_dic['Cases of COVID-19'].append(Cases)
df_Switzerland = pd.DataFrame(Switzerland_dic)
```

Let’s make a line plot for UK and then for China.

[10]:

```
plt.figure(figsize=(18, 7))
sns.set(style="whitegrid")
sns.lineplot(x="Days Since Outbreak", y="Cases of COVID-19", data=df_UK)
plt.suptitle('Increase in COVID-19 cases in UK after January 21st')
```

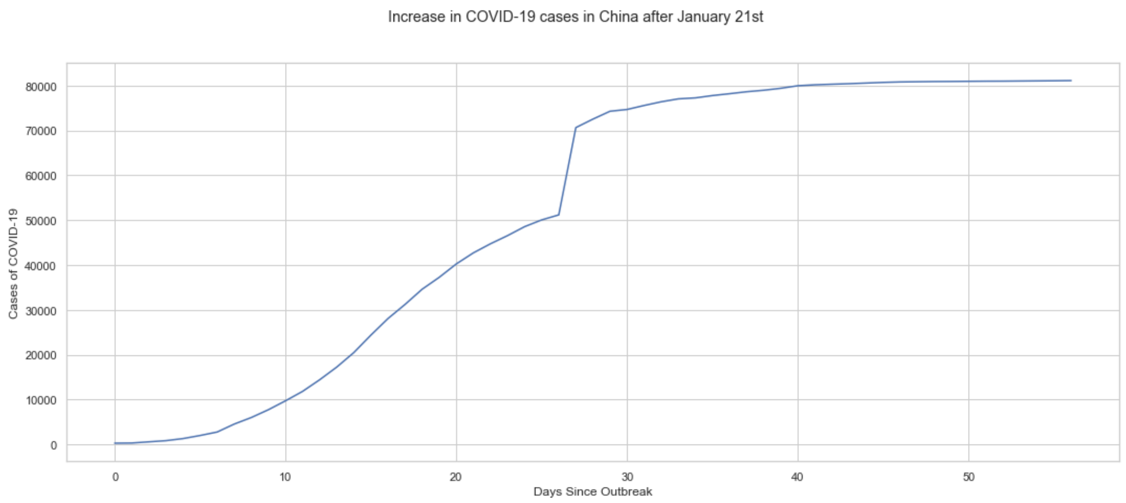
```
[10]: Text(0.5, 0.98, 'Increase in COVID-19 cases in UK after January 21st')
```



As it can be seen, Cases were relatively low until the 40 days. After which we see an exponential increase.

```
[11]: plt.figure(figsize=(18, 7))
      sns.set(style="whitegrid")
      sns.lineplot(x="Days Since Outbreak", y="Cases of COVID-19", data=df_China)
      plt.suptitle('Increase in COVID-19 cases in China after January 21st')
```

```
[11]: Text(0.5, 0.98, 'Increase in COVID-19 cases in China after January 21st')
```

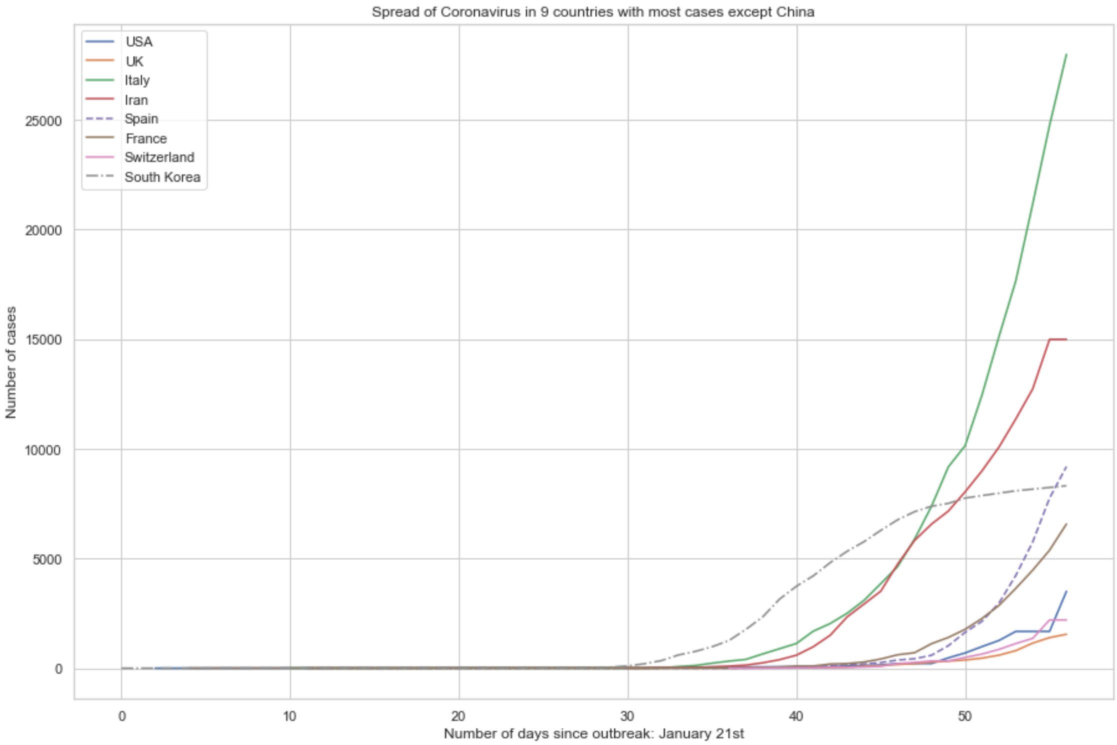


It seems we see an exponential raise in daily number of cases in China untill day 30. After which, Due to preventive and protective measures **China** took, the curve has relatively flattened.

Now we will show spread of COVID-19 in 9 countries with highest number of cases. **China** is excluded in this graph as it makes a very unpleasent visualization.

[12]:

```
fig=plt.figure(figsize=(15,10))
ax=fig.add_subplot(111)
ax.set_title('Spread of Coronavirus in 9 countries with most cases except China')
plt.xlabel('Number of days since outbreak: January 21st')
plt.ylabel('Number of cases')
#Please uncomment the line below if want to include China.
#ax.plot(df_China['Days Since Outbreak'],df_China['Cases of COVID-19'],␣
 ↪label='China')
ax.plot(df_US['Days Since Outbreak'],df_US['Cases of COVID-19'], label='USA')
ax.plot(df_UK['Days Since Outbreak'],df_UK['Cases of COVID-19'], label='UK')
ax.plot(df_Italy['Days Since Outbreak'],df_Italy['Cases of COVID-19'],␣
 ↪label='Italy')
ax.plot(df_Iran['Days Since Outbreak'],df_Iran['Cases of COVID-19'],␣
 ↪label='Iran')
ax.plot(df_Spain['Days Since Outbreak'],df_Spain['Cases of COVID-19'],'--',␣
 ↪label='Spain')
ax.plot(df_France['Days Since Outbreak'],df_France['Cases of COVID-19'],␣
 ↪label='France')
ax.plot(df_Switzerland['Days Since Outbreak'],df_Switzerland['Cases of␣
 ↪COVID-19']\
        , label='Switzerland')
ax.plot(df_South_Korea['Days Since Outbreak'],df_South_Korea['Cases of␣
 ↪COVID-19'],'-.', label='South Korea')
plt.legend(loc='best')
plt.show()
```



The graph shows interesting information. It clearly shows, Outside of China, **Italy** has the highest amount of COVID-19 spread. The graph shows cases first started to rise exponentially in **South Korea** around day 30 after outbreak. Slowly after, cases started to rise at a similar exponential rate in **Iran** and **Italy**. While every country's number of cases increase by the day, **South Korea** and **China's** curve flattens relatively around day 45 and 30 respectively.