An update on mortality and morbidity rate to track covid-19 outbreak - A case study

October 24, 2023

1 An udpade on mortality and morbidity global rates to track covid-19 outbreak - A case study.

1.1 # Background:

- In December, 2019, a local outbreak of pneumonia of initially unknown cause was detected in Wuhan (Hubei, China), and was quickly identified to be caused by a novel coronavirus, namely severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The outbreak has since spread to every province of mainland China as well as 27 other countries and regions, with more than 70 000 confirmed cases as of Feb 17, 2020. In response to this ongoing public health emergency, an online interactive dashboard, hosted by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University, Baltimore, MD, USA, to visualise and track reported cases of coronavirus disease 2019 (COVID-19) in real time. All data collected and displayed are made freely available, initially through Google Sheets and now through a GitHub repository, along with the feature layers of the dashboard, which are now included in the Esri Living Atlas. On March 10, 2023, the Johns Hopkins Coronavirus Resource Center ceased its collecting and reporting of global COVID-19 data * —

1.2 # Objective:

- Understanding and identifying any trends on confirmed (positive), death(mortality), active(recovered) cases * —

1.3 # Method:

- Data was collated from Novel Coronavirus (COVID-19) Cases, provided by JHU CSSE, the data repository for the 2019 Novel Coronavirus Visual Dashboard operated by the Johns Hopkins University Center for Systems Science and Engineering (JHU CSSE). Also, Supported by ESRI Living Atlas Team and the Johns Hopkins University Applied Physics Lab (JHU APL). An opendata source was used to retrieve data [this is a link].(https://github.com/CSSEGISandData/COVID-19). * —

[132]:

```
## Importing libraries for data aquisition and evidence syntheis

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.style as style
style.available
import seaborn as sns
%matplotlib inline

from sklearn.linear_model import LinearRegression, BayesianRidge
from sklearn.model_selection import RandomizedSearchCV, train_test_split
from sklearn.preprocessing import PolynomialFeatures
from sklearn.metrics import mean_squared_error, mean_absolute_error
```

[133]:

```
## Graphical preparation

import plotly.express as px
import plotly.graph_objs as go
from plotly.subplots import make_subplots
```

[134]:

```
## Using Covid-19 CSSE at John Hopkins University data from J.H github␣
 ↪repositoiry

positive_df = pd.read_csv('https://raw.githubusercontent.com/CSSEGISandData/
 ↪COVID-19/master/csse_covid_19_data/csse_covid_19_time_series/
 ↪time_series_covid19_confirmed_global.csv')
mortality_df = pd.read_csv('https://raw.githubusercontent.com/CSSEGISandData/
 ↪COVID-19/master/csse_covid_19_data/csse_covid_19_time_series/
 ↪time_series_covid19_deaths_global.csv')
morbidity_df = pd.read_csv('https://raw.githubusercontent.com/CSSEGISandData/
 ↪COVID-19/master/csse_covid_19_data/csse_covid_19_time_series/
 ↪time_series_covid19_recovered_global.csv')
```

2 An overview of the data sets

[136]:

```
### Shape of the data sets

print(positive_df.shape)
print(mortality_df.shape)
print(morbidity_df.shape)
```

```
(289, 1147)
(289, 1147)
(274, 1147)
```

[137]:

```
### Content in the data set

positive_df.head()
```

[137]:

```
  Province/State Country/Region       Lat       Long  1/22/20  1/23/20  \
0            NaN    Afghanistan  33.93911  67.709953        0        0
1            NaN        Albania  41.15330  20.168300        0        0
2            NaN        Algeria  28.03390   1.659600        0        0
3            NaN        Andorra  42.50630   1.521800        0        0
4            NaN         Angola -11.20270  17.873900        0        0

   1/24/20  1/25/20  1/26/20  1/27/20  …  2/28/23  3/1/23  3/2/23  3/3/23  \
0        0        0        0        0  …   209322  209340  209358  209362
1        0        0        0        0  …   334391  334408  334408  334427
2        0        0        0        0  …   271441  271448  271463  271469
3        0        0        0        0  …    47866   47875   47875   47875
4        0        0        0        0  …   105255  105277  105277  105277

   3/4/23  3/5/23  3/6/23  3/7/23  3/8/23  3/9/23
0  209369  209390  209406  209436  209451  209451
1  334427  334427  334427  334427  334443  334457
2  271469  271477  271477  271490  271494  271496
3   47875   47875   47875   47875   47890   47890
4  105277  105277  105277  105277  105288  105288

[5 rows x 1147 columns]
```

[138]:

```
mortality_df.head()
```

[138]:

```
  Province/State Country/Region       Lat       Long  1/22/20  1/23/20  \
0            NaN    Afghanistan  33.93911  67.709953        0        0
1            NaN        Albania  41.15330  20.168300        0        0
2            NaN        Algeria  28.03390   1.659600        0        0
3            NaN        Andorra  42.50630   1.521800        0        0
4            NaN         Angola -11.20270  17.873900        0        0

   1/24/20  1/25/20  1/26/20  1/27/20  …  2/28/23  3/1/23  3/2/23  3/3/23  \
0        0        0        0        0  …     7896    7896    7896    7896
1        0        0        0        0  …     3598    3598    3598    3598
2        0        0        0        0  …     6881    6881    6881    6881
3        0        0        0        0  …      165     165     165     165
4        0        0        0        0  …     1933    1933    1933    1933

   3/4/23  3/5/23  3/6/23  3/7/23  3/8/23  3/9/23
0    7896    7896    7896    7896    7896    7896
1    3598    3598    3598    3598    3598    3598
2    6881    6881    6881    6881    6881    6881
3     165     165     165     165     165     165
4    1933    1933    1933    1933    1933    1933

[5 rows x 1147 columns]
```

[139]:

```
morbidity_df.head()
```

[139]:

```
   Province/State Country/Region       Lat       Long  1/22/20  1/23/20  \
0             NaN    Afghanistan  33.93911  67.709953        0        0
1             NaN        Albania  41.15330  20.168300        0        0
2             NaN        Algeria  28.03390   1.659600        0        0
3             NaN        Andorra  42.50630   1.521800        0        0
4             NaN         Angola -11.20270  17.873900        0        0

   1/24/20  1/25/20  1/26/20  1/27/20  …  2/28/23  3/1/23  3/2/23  3/3/23  \
0        0        0        0        0  …        0       0       0       0
1        0        0        0        0  …        0       0       0       0
2        0        0        0        0  …        0       0       0       0
3        0        0        0        0  …        0       0       0       0
4        0        0        0        0  …        0       0       0       0

   3/4/23  3/5/23  3/6/23  3/7/23  3/8/23  3/9/23
0       0       0       0       0       0       0
1       0       0       0       0       0       0
2       0       0       0       0       0       0
3       0       0       0       0       0       0
4       0       0       0       0       0       0

[5 rows x 1147 columns]
```

[140]:

```
### Identifying missing values within each data sets

positive_df.isna().sum()
```

[140]:

```
Province/State    198
Country/Region      0
Lat                 2
Long                2
1/22/20             0
                 …
3/5/23              0
3/6/23              0
3/7/23              0
3/8/23              0
3/9/23              0
Length: 1147, dtype: int64
```

[141]:

```
mortality_df.isna().sum()
```

[141]:

```
Province/State    198
Country/Region      0
Lat                 2
```

```
Long                 2
1/22/20              0
                  …
3/5/23               0
3/6/23               0
3/7/23               0
3/8/23               0
3/9/23               0
Length: 1147, dtype: int64
```

[142]:
```
morbidity_df.isna().sum()
```

[142]:
```
Province/State     199
Country/Region       0
Lat                  1
Long                 1
1/22/20              0
                  …
3/5/23               0
3/6/23               0
3/7/23               0
3/8/23               0
3/9/23               0
Length: 1147, dtype: int64
```

[143]:
```
### Identifying unique values within the data sets

positive_df.nunique()
```

[143]:
```
Province/State      91
Country/Region     201
Lat                283
Long               284
1/22/20             11
                  …
3/5/23             287
3/6/23             287
3/7/23             287
3/8/23             287
3/9/23             287
Length: 1147, dtype: int64
```

[144]:
```
mortality_df.nunique()
```

[144]:
```
Province/State      91
Country/Region     201
Lat                283
```

```
Long                284
1/22/20               2
                   …
3/5/23              244
3/6/23              243
3/7/23              243
3/8/23              243
3/9/23              242
Length: 1147, dtype: int64
```

[145]:
```
morbidity_df.nunique()
```

[145]:
```
Province/State       75
Country/Region      201
Lat                 272
Long                272
1/22/20               3
                   …
3/5/23                1
3/6/23                1
3/7/23                1
3/8/23                1
3/9/23                1
Length: 1147, dtype: int64
```

[146]:
```
### Counting multiple entry by country/region

positive_df['Country/Region'].value_counts()
```

[146]:
```
China               34
Canada              16
United Kingdom      15
France              12
Australia            8
                    ..
Guinea               1
Guinea-Bissau        1
Guyana               1
Haiti                1
Zimbabwe             1
Name: Country/Region, Length: 201, dtype: int64
```

[147]:
```
mortality_df['Country/Region'].value_counts()
```

[147]:
```
China               34
Canada              16
United Kingdom      15
```

```
France             12
Australia           8
                   ..
Guinea              1
Guinea-Bissau       1
Guyana              1
Haiti               1
Zimbabwe            1
Name: Country/Region, Length: 201, dtype: int64
```

[148]:

```
morbidity_df['Country/Region'].value_counts()
```

[148]:

```
China              34
United Kingdom     15
France             12
Australia           8
Netherlands         5
                   ..
Guinea              1
Guinea-Bissau       1
Guyana              1
Haiti               1
Zimbabwe            1
Name: Country/Region, Length: 201, dtype: int64
```

[149]:

```
## Data cleaning

## Changing the coloumns 'Province/State' & 'Country/Region' & change latest␣
 ↪date to 'Current'.
```

[150]:

```
col=positive_df.columns[-1]

positive_df.rename(columns = {'Province/State' : 'Province', 'Country/Region' :␣
 ↪'Country', col : 'Current'},inplace = True)
mortality_df.rename(columns = {'Province/State' : 'Province', 'Country/Region' :
 ↪ 'Country', col : 'Current'},inplace = True)
morbidity_df.rename(columns = {'Province/State' : 'Province', 'Country/Region' :
 ↪ 'Country', col : 'Current'},inplace = True)
positive_df.head(3)
mortality_df.head(3)
morbidity_df.head(3)
```

[150]:

```
  Province      Country       Lat       Long  1/22/20  1/23/20  1/24/20  \
0      NaN  Afghanistan  33.93911  67.709953        0        0        0
1      NaN      Albania  41.15330  20.168300        0        0        0
2      NaN      Algeria  28.03390   1.659600        0        0        0
```

```
   1/25/20  1/26/20  1/27/20  …  2/28/23  3/1/23  3/2/23  3/3/23  3/4/23  \
0        0        0        0  …        0       0       0       0       0
1        0        0        0  …        0       0       0       0       0
2        0        0        0  …        0       0       0       0       0

   3/5/23  3/6/23  3/7/23  3/8/23  Current
0       0       0       0       0        0
1       0       0       0       0        0
2       0       0       0       0        0

[3 rows x 1147 columns]
```

[151]:

```
## Creating new data frame through combining unique country entries
```

[152]:

```
### Positive cases

positive = pd.DataFrame(positive_df.groupby('Country').sum())
positive.reset_index(inplace = True)
positive.head(5)
```

```
/tmp/ipykernel_1139/1101471026.py:3: FutureWarning:

The default value of numeric_only in DataFrameGroupBy.sum is deprecated. In a
future version, numeric_only will default to False. Either specify numeric_only
or select only columns which should be valid for the function.
```

[152]:

```
       Country       Lat       Long  1/22/20  1/23/20  1/24/20  1/25/20  \
0  Afghanistan  33.93911  67.709953        0        0        0        0
1      Albania  41.15330  20.168300        0        0        0        0
2      Algeria  28.03390   1.659600        0        0        0        0
3      Andorra  42.50630   1.521800        0        0        0        0
4       Angola -11.20270  17.873900        0        0        0        0

   1/26/20  1/27/20  1/28/20  …  2/28/23  3/1/23  3/2/23  3/3/23  3/4/23  \
0        0        0        0  …   209322  209340  209358  209362  209369
1        0        0        0  …   334391  334408  334408  334427  334427
2        0        0        0  …   271441  271448  271463  271469  271469
3        0        0        0  …    47866   47875   47875   47875   47875
4        0        0        0  …   105255  105277  105277  105277  105277

   3/5/23  3/6/23  3/7/23  3/8/23  Current
0  209390  209406  209436  209451   209451
1  334427  334427  334427  334443   334457
2  271477  271477  271490  271494   271496
3   47875   47875   47875   47890    47890
4  105277  105277  105277  105288   105288
```

```
[5 rows x 1146 columns]
```

[153]:

```
### Moratlity cases

mortality = pd.DataFrame(mortality_df.groupby('Country').sum())
mortality.reset_index(inplace = True)
mortality.head(5)
```

```
/tmp/ipykernel_1139/1933718209.py:3: FutureWarning:

The default value of numeric_only in DataFrameGroupBy.sum is deprecated. In a
future version, numeric_only will default to False. Either specify numeric_only
or select only columns which should be valid for the function.
```

[153]:

```
       Country       Lat       Long  1/22/20  1/23/20  1/24/20  1/25/20  \
0  Afghanistan  33.93911  67.709953        0        0        0        0
1      Albania  41.15330  20.168300        0        0        0        0
2      Algeria  28.03390   1.659600        0        0        0        0
3      Andorra  42.50630   1.521800        0        0        0        0
4       Angola -11.20270  17.873900        0        0        0        0

   1/26/20  1/27/20  1/28/20  …  2/28/23  3/1/23  3/2/23  3/3/23  3/4/23  \
0        0        0        0  …     7896    7896    7896    7896    7896
1        0        0        0  …     3598    3598    3598    3598    3598
2        0        0        0  …     6881    6881    6881    6881    6881
3        0        0        0  …      165     165     165     165     165
4        0        0        0  …     1933    1933    1933    1933    1933

   3/5/23  3/6/23  3/7/23  3/8/23  Current
0    7896    7896    7896    7896     7896
1    3598    3598    3598    3598     3598
2    6881    6881    6881    6881     6881
3     165     165     165     165      165
4    1933    1933    1933    1933     1933

[5 rows x 1146 columns]
```

[154]:

```
### Morbidity cases

morbidity = pd.DataFrame(morbidity_df.groupby('Country').sum())
morbidity.reset_index(inplace = True)
morbidity.head(5)
```

```
/tmp/ipykernel_1139/3587905092.py:3: FutureWarning:

The default value of numeric_only in DataFrameGroupBy.sum is deprecated. In a
```

```
future version, numeric_only will default to False. Either specify numeric_only
or select only columns which should be valid for the function.
```

[154]:
```
       Country       Lat       Long  1/22/20  1/23/20  1/24/20  1/25/20  \
0  Afghanistan  33.93911  67.709953        0        0        0        0
1      Albania  41.15330  20.168300        0        0        0        0
2      Algeria  28.03390   1.659600        0        0        0        0
3      Andorra  42.50630   1.521800        0        0        0        0
4       Angola -11.20270  17.873900        0        0        0        0

   1/26/20  1/27/20  1/28/20  …  2/28/23  3/1/23  3/2/23  3/3/23  3/4/23  \
0        0        0        0  …        0       0       0       0       0
1        0        0        0  …        0       0       0       0       0
2        0        0        0  …        0       0       0       0       0
3        0        0        0  …        0       0       0       0       0
4        0        0        0  …        0       0       0       0       0

   3/5/23  3/6/23  3/7/23  3/8/23  Current
0       0       0       0       0        0
1       0       0       0       0        0
2       0       0       0       0        0
3       0       0       0       0        0
4       0       0       0       0        0

[5 rows x 1146 columns]
```

[155]:
```python
### Eliminating cordination data (latitude and Longitude)

col = positive['Country']
positive.drop(['Lat','Long'],axis=1,inplace=True)
positive.head(3)
```

[155]:
```
       Country  1/22/20  1/23/20  1/24/20  1/25/20  1/26/20  1/27/20  1/28/20  \
0  Afghanistan        0        0        0        0        0        0        0
1      Albania        0        0        0        0        0        0        0
2      Algeria        0        0        0        0        0        0        0

   1/29/20  1/30/20  …  2/28/23  3/1/23  3/2/23  3/3/23  3/4/23  3/5/23  \
0        0        0  …   209322  209340  209358  209362  209369  209390
1        0        0  …   334391  334408  334408  334427  334427  334427
2        0        0  …   271441  271448  271463  271469  271469  271477

   3/6/23  3/7/23  3/8/23  Current
0  209406  209436  209451   209451
1  334427  334427  334443   334457
2  271477  271490  271494   271496
```

```
[3 rows x 1144 columns]
```

[156]:
```
col = mortality['Country']
mortality.drop(['Lat','Long'],axis=1,inplace=True)
mortality.head(3)
```

[156]:
```
       Country  1/22/20  1/23/20  1/24/20  1/25/20  1/26/20  1/27/20  1/28/20  \
0  Afghanistan        0        0        0        0        0        0        0
1      Albania        0        0        0        0        0        0        0
2      Algeria        0        0        0        0        0        0        0

   1/29/20  1/30/20  …  2/28/23  3/1/23  3/2/23  3/3/23  3/4/23  3/5/23  \
0        0        0  …     7896    7896    7896    7896    7896    7896
1        0        0  …     3598    3598    3598    3598    3598    3598
2        0        0  …     6881    6881    6881    6881    6881    6881

   3/6/23  3/7/23  3/8/23  Current
0    7896    7896    7896     7896
1    3598    3598    3598     3598
2    6881    6881    6881     6881

[3 rows x 1144 columns]
```

[157]:
```
col = morbidity['Country']
morbidity.drop(['Lat','Long'],axis=1,inplace=True)
morbidity.head(3)
```

[157]:
```
       Country  1/22/20  1/23/20  1/24/20  1/25/20  1/26/20  1/27/20  1/28/20  \
0  Afghanistan        0        0        0        0        0        0        0
1      Albania        0        0        0        0        0        0        0
2      Algeria        0        0        0        0        0        0        0

   1/29/20  1/30/20  …  2/28/23  3/1/23  3/2/23  3/3/23  3/4/23  3/5/23  \
0        0        0  …        0       0       0       0       0       0
1        0        0  …        0       0       0       0       0       0
2        0        0  …        0       0       0       0       0       0

   3/6/23  3/7/23  3/8/23  Current
0       0       0       0        0
1       0       0       0        0
2       0       0       0        0

[3 rows x 1144 columns]
```

[158]:
```
## Calculating active cases
```

[159]:
```
### Creating new data frame of Active cases

active= positive.copy()
for i in active.columns[1:]:
    active[i] =active[i] - mortality[i]
active.head()
```

[159]:
```
       Country  1/22/20  1/23/20  1/24/20  1/25/20  1/26/20  1/27/20  1/28/20  \
0  Afghanistan        0        0        0        0        0        0        0
1      Albania        0        0        0        0        0        0        0
2      Algeria        0        0        0        0        0        0        0
3      Andorra        0        0        0        0        0        0        0
4       Angola        0        0        0        0        0        0        0

   1/29/20  1/30/20  …  2/28/23  3/1/23  3/2/23  3/3/23  3/4/23  3/5/23  \
0        0        0  …   201426  201444  201462  201466  201473  201494
1        0        0  …   330793  330810  330810  330829  330829  330829
2        0        0  …   264560  264567  264582  264588  264588  264596
3        0        0  …    47701   47710   47710   47710   47710   47710
4        0        0  …   103322  103344  103344  103344  103344  103344

   3/6/23  3/7/23  3/8/23  Current
0  201510  201540  201555   201555
1  330829  330829  330845   330859
2  264596  264609  264613   264615
3   47710   47710   47725    47725
4  103344  103344  103355   103355

[5 rows x 1144 columns]
```

[160]:
```
## Data analysis
```

[161]:
```
## Overall cases for each conditions
```

[162]:
```
print("Positive Cases :" , positive.iloc[:,-1].sum())
print("Mortality Cases :" , mortality.iloc[:,-1].sum())
print("Active Cases :", active.iloc[:,-1].sum())
```

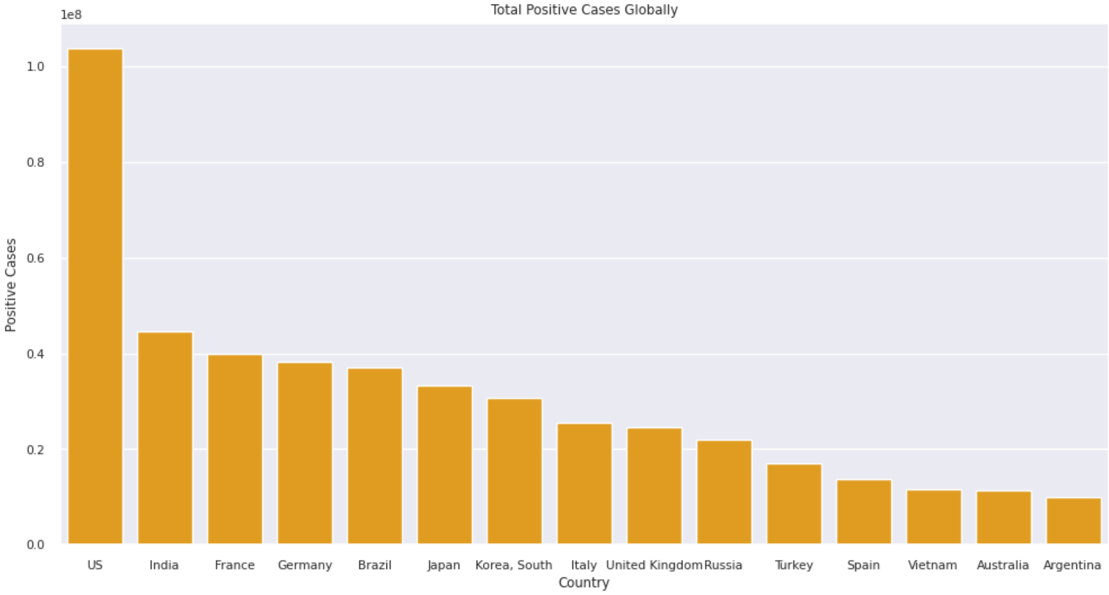
```
Positive Cases : 676570149
Mortality Cases : 6881802
Active Cases : 669688347
```

[163]:
```
## Highest records of countries per each conditions.
```

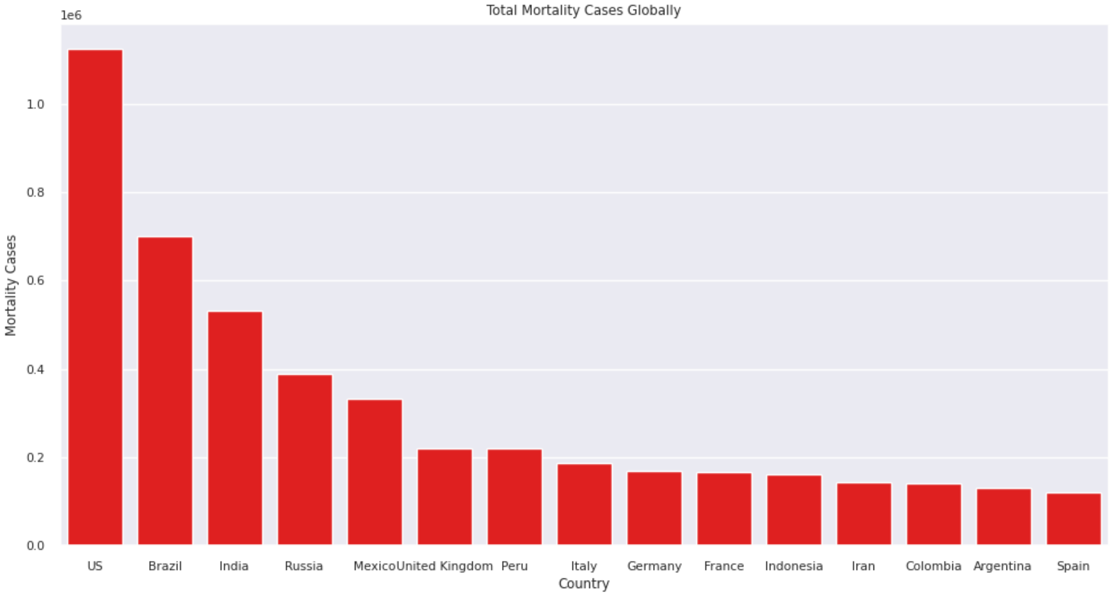
[164]:
```
positive_data = positive[['Country','Current']].sort_values('Current',ascending␣
 ↪= False)
```

```
mortality_data = mortality[['Country','Current']].
 ↪sort_values('Current',ascending = False)
active_data = active[['Country','Current']].sort_values('Current',ascending =␣
 ↪False)
```

[165]:
```
### Positive cases

sns.set(font_scale=0.7)
plt.figure(figsize=(12, 6))
fig= sns.barplot(x='Country', y='Current', data=positive_data[:15],␣
 ↪orient='v',color='Orange')
plt.title('Total Positive Cases Globally')
fig.set(xlabel ='Country', ylabel ='Positive Cases')
plt.show()
```

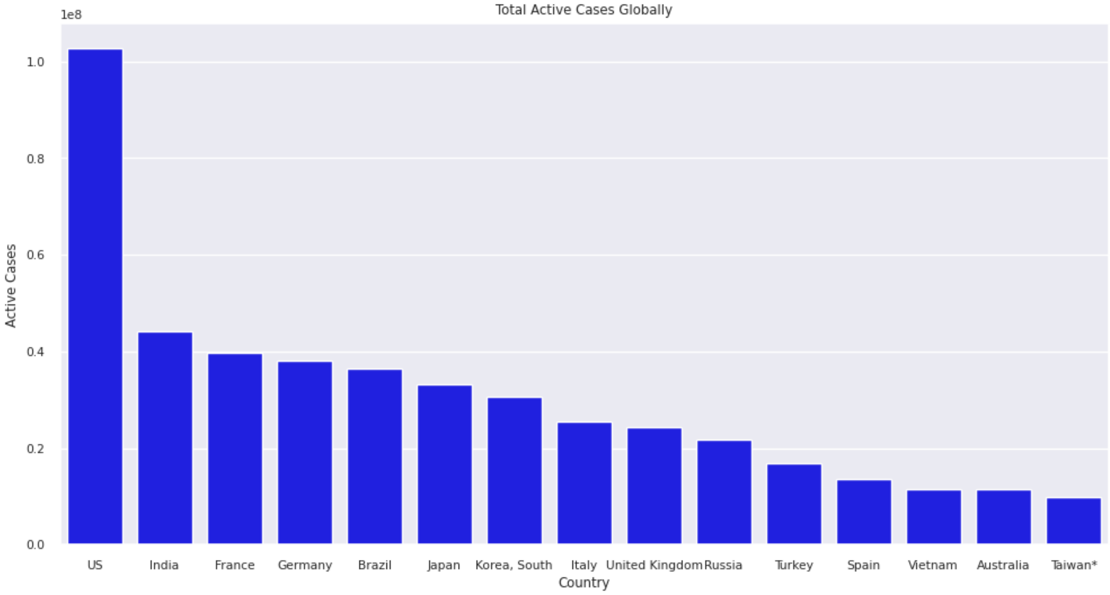


[166]:
```
### Mortality cases

sns.set(font_scale=0.7)
plt.figure(figsize=(12, 6))
fig= sns.barplot(x='Country', y='Current', data=mortality_data[:15],␣
 ↪orient='v',color='Red')
plt.title('Total Mortality Cases Globally')
fig.set(xlabel ='Country', ylabel ='Mortality Cases')
plt.show()
```



[167]:

```
### Active cases

sns.set(font_scale=0.7)
plt.figure(figsize=(12, 6))
fig= sns.barplot(x='Country', y='Current', data=active_data[:15],␣
 ↪orient='v',color='blue')
plt.title('Total Active Cases Globally')
fig.set(xlabel ='Country', ylabel ='Active Cases')
plt.show()
```



[168]:

```
## Total cases in UK, USA, Australia, India, Brazil, South Africa
```

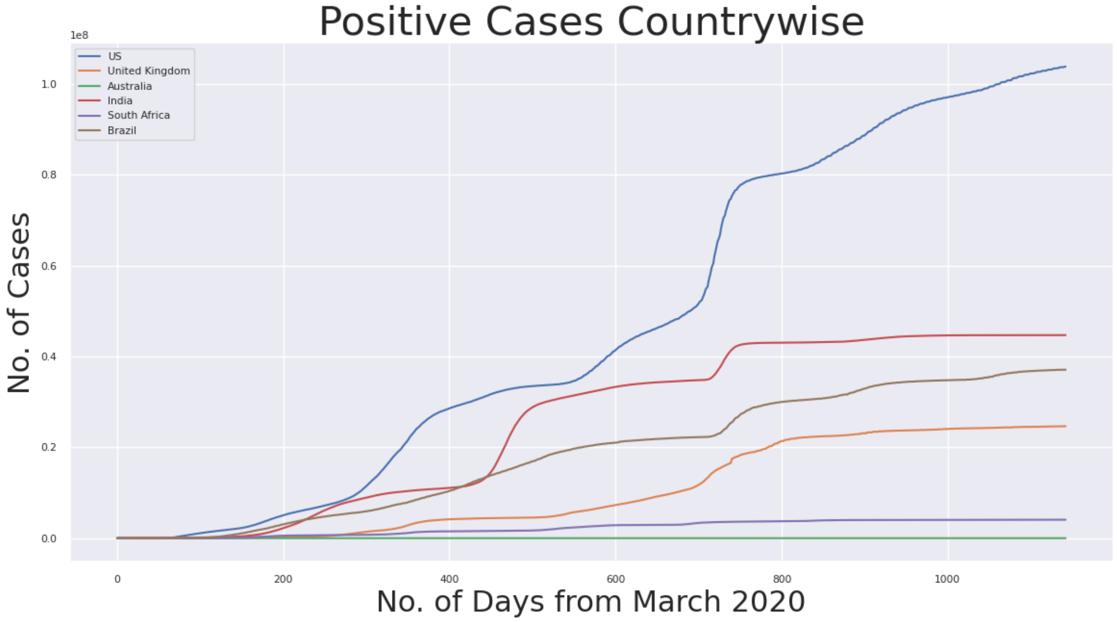
[169]:

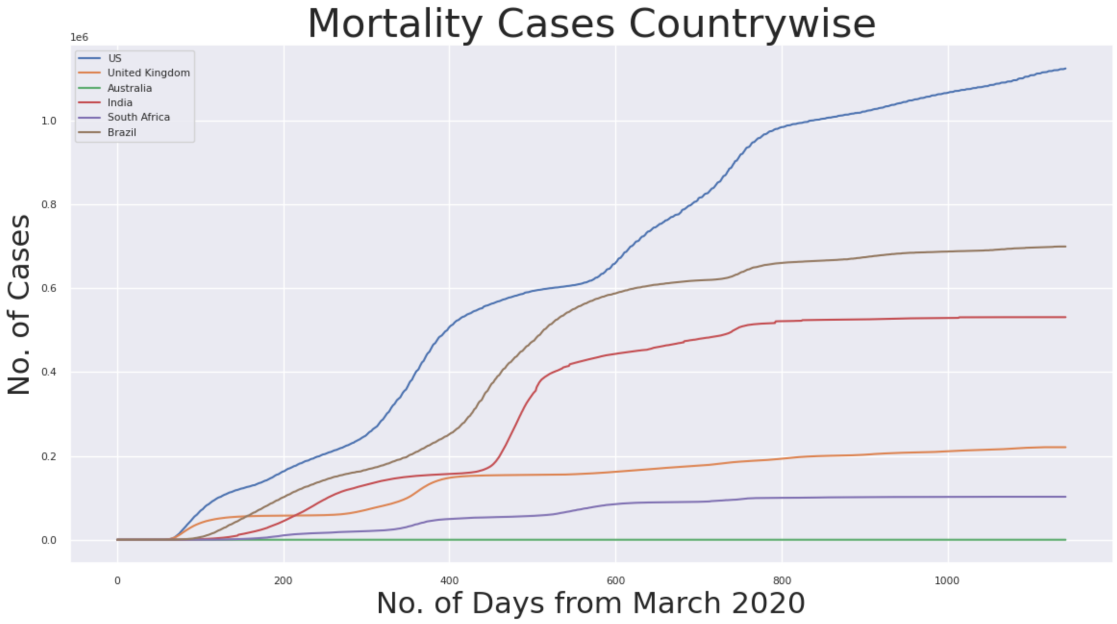
```
### Total positive cases in UK, USA, Australia, India, Brazil, South Africa

usa_positive = positive[positive.Country == 'US'].iloc[:,1:].sum().values.
 ↪tolist()
uk_positive = positive[positive.Country == 'United Kingdom'].iloc[:,1:].sum().
 ↪values.tolist()
australia_positive = positive[positive.Country == 'Austrlia'].iloc[:,1:].sum().
 ↪values.tolist()
india_positive = positive[positive.Country == 'India'].iloc[:,1:].sum().values.
 ↪tolist()
sa_positive = positive[positive.Country == 'South Africa'].iloc[:,1:].sum().
 ↪values.tolist()
brazil_positive = positive[positive.Country == 'Brazil'].iloc[:,1:].sum().
 ↪values.tolist()

### Total mortality cases in UK, USA, Australia, India, Brazil, South Africa

usa_mortality = mortality[mortality.Country == 'US'].iloc[:,1:].sum().values.
 ↪tolist()
uk_mortality = mortality[mortality.Country == 'United Kingdom'].iloc[:,1:].
 ↪sum().values.tolist()
australia_mortality = mortality[mortality.Country == 'Austrlia'].iloc[:,1:].
 ↪sum().values.tolist()
india_mortality = mortality[mortality.Country == 'India'].iloc[:,1:].sum().
 ↪values.tolist()
sa_mortality = mortality[mortality.Country == 'South Africa'].iloc[:,1:].sum().
 ↪values.tolist()
brazil_mortality = mortality[mortality.Country == 'Brazil'].iloc[:,1:].sum().
 ↪values.tolist()

### Total active cases in UK, USA, Australia, India, Brazil, South Africa

usa_active = active[active.Country == 'US'].iloc[:,1:].sum().values.tolist()
uk_active = active[active.Country == 'United Kingdom'].iloc[:,1:].sum().values.
 ↪tolist()
australia_active = active[active.Country == 'Austrlia'].iloc[:,1:].sum().values.
 ↪tolist()
india_active = active[active.Country == 'India'].iloc[:,1:].sum().values.
 ↪tolist()
sa_active = active[active.Country == 'South Africa'].iloc[:,1:].sum().values.
 ↪tolist()
```

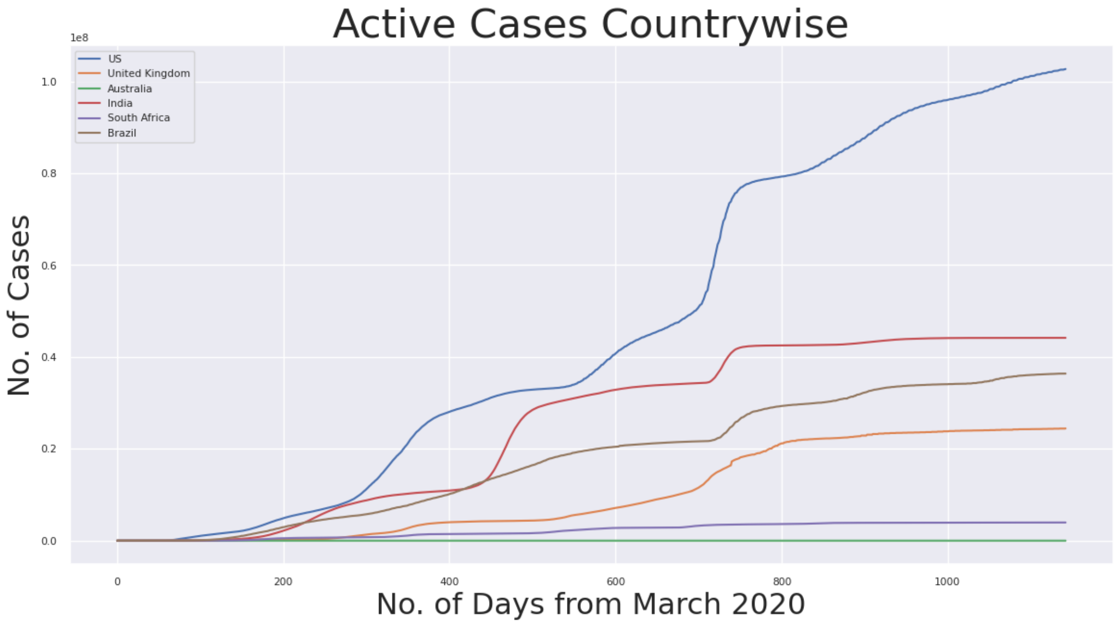
```
brazil_active = active[active.Country == 'Brazil'].iloc[:,1:].sum().values.
 ↪tolist()
```

[170]:

```
### Positive cases

plt.figure(figsize=(14,7))
plt.plot(usa_positive)
plt.plot(uk_positive)
plt.plot(australia_positive)
plt.plot(india_positive)
plt.plot(sa_positive)
plt.plot(brazil_positive)

plt.title('Positive Cases Countrywise', size=30)
plt.xlabel('No. of Days from March 2020', size=22)
plt.ylabel('No. of Cases', size=22)
plt.legend(['US', 'United Kingdom','Australia','India','South Africa','Brazil'])
plt.show()

### Mortality cases

plt.figure(figsize=(14,7))
plt.plot(usa_mortality)
plt.plot(uk_mortality)
plt.plot(australia_mortality)
plt.plot(india_mortality)
plt.plot(sa_mortality)
plt.plot(brazil_mortality)

plt.title('Mortality Cases Countrywise', size=30)
plt.xlabel('No. of Days from March 2020', size=22)
plt.ylabel('No. of Cases', size=22)
plt.legend(['US', 'United Kingdom','Australia','India','South Africa','Brazil'])
plt.show()

### Active cases

plt.figure(figsize=(14,7))
plt.plot(usa_active)
plt.plot(uk_active)
plt.plot(australia_active)
plt.plot(india_active)
plt.plot(sa_active)
plt.plot(brazil_active)

plt.title('Active Cases Countrywise', size=30)
plt.xlabel('No. of Days from March 2020', size=22)
plt.ylabel('No. of Cases', size=22)
plt.legend(['US', 'United Kingdom','Australia','India','South Africa','Brazil'])
plt.show()
```



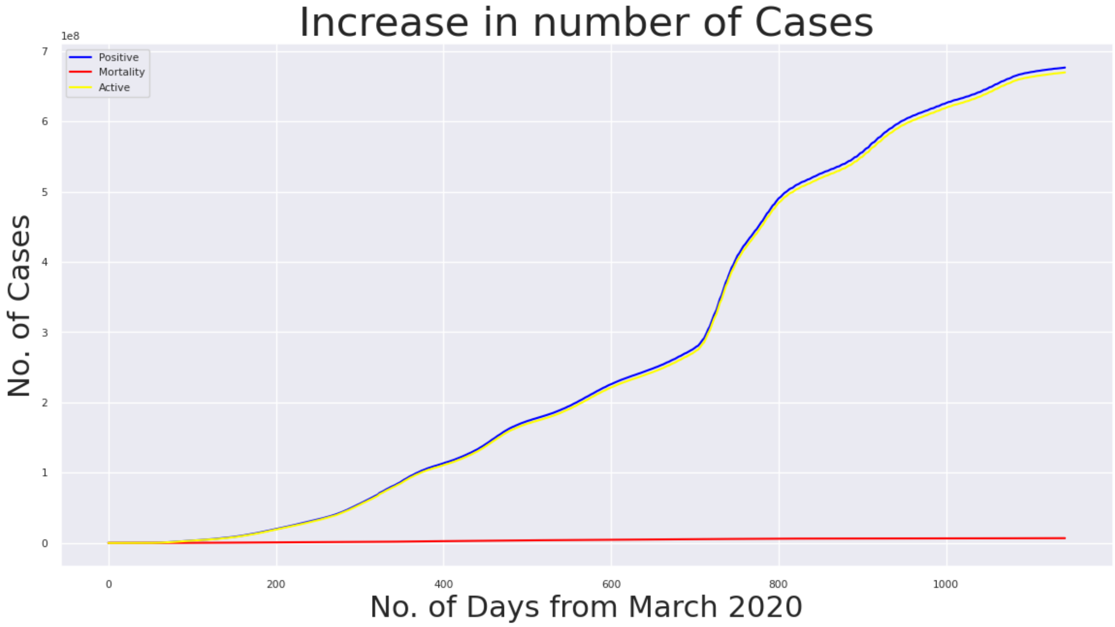




```
[171]: # Initial Results:

       ## Initailly the number of positive cases was increasing each month for all the␣
        ↪countries, following the identified number came to a constant rate since two␣
        ↪years from the outbreat, except the United States.
       ## The mortality and active state of cases follwed a similar patter across the␣
        ↪countries.
       ## Australia was identified to have an extremly low rates with positive,␣
        ↪mortality and active cases untill now, having US the quite opposite with␣
        ↪hisghest rates.
```

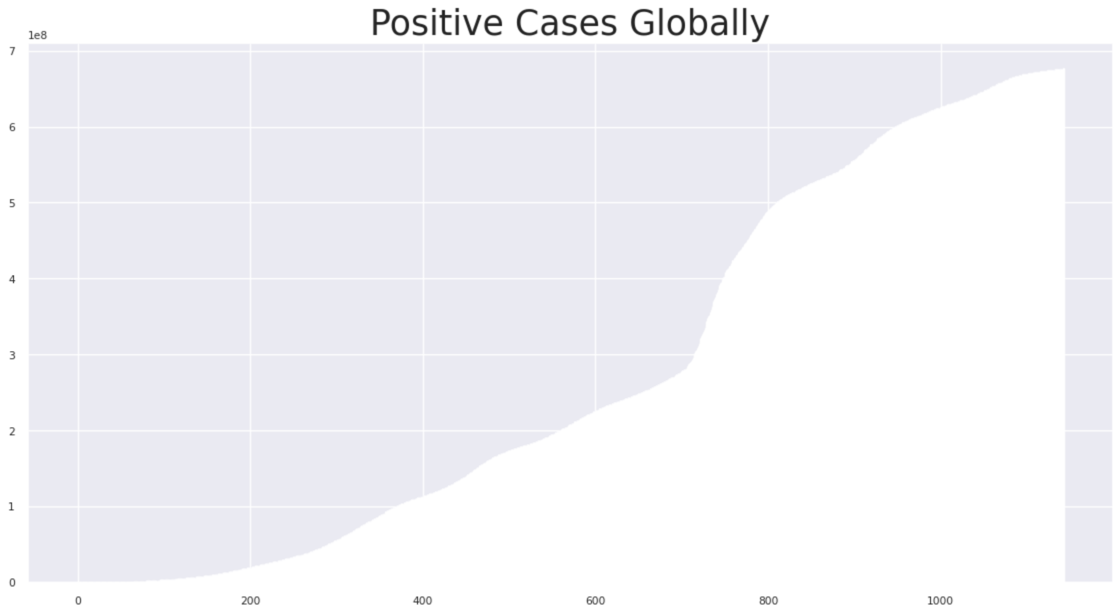
```
[172]: ### The rate of each conditions since March 2020

       positive_date = positive.iloc[:,1:].sum().values.tolist()
       mortality_date = mortality.iloc[:,1:].sum().values.tolist()
       active_date = active.iloc[:,1:].sum().values.tolist()
```

```
[173]: plt.figure(figsize=(14,7))
       plt.plot(positive_date,color='Blue')
       plt.plot(mortality_date,color='Red')
       plt.plot(active_date,color='Yellow')

       plt.xlabel('No. of Days from March 2020',size=22)
       plt.ylabel('No. of Cases',size=22)
       plt.title('Increase in number of Cases',size=30)
       plt.legend(['Positive','Mortality','Active'])
plt.show()
```

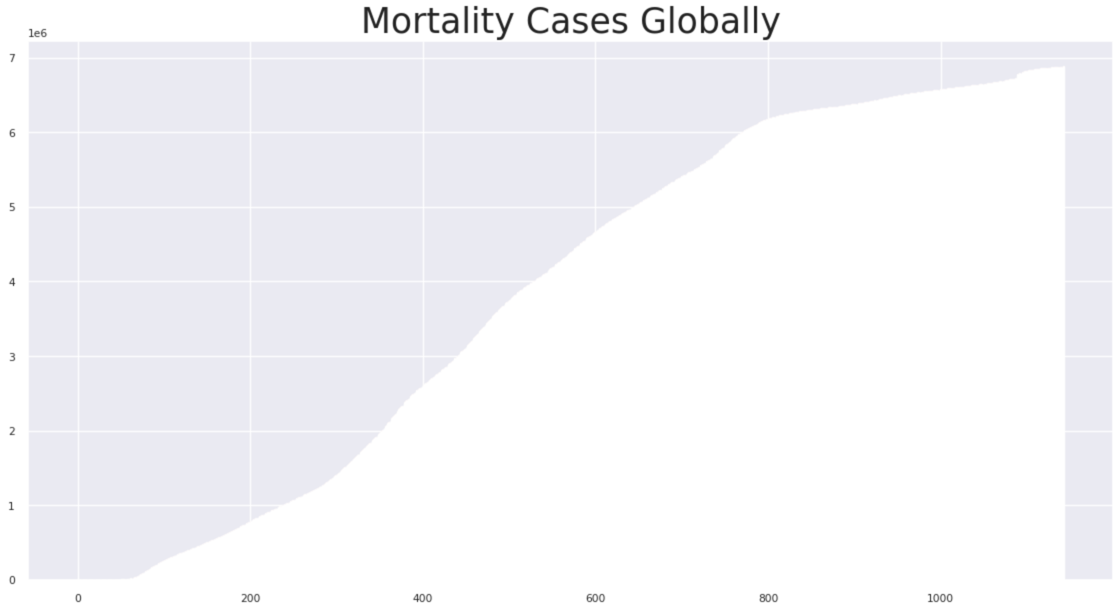


[174]:

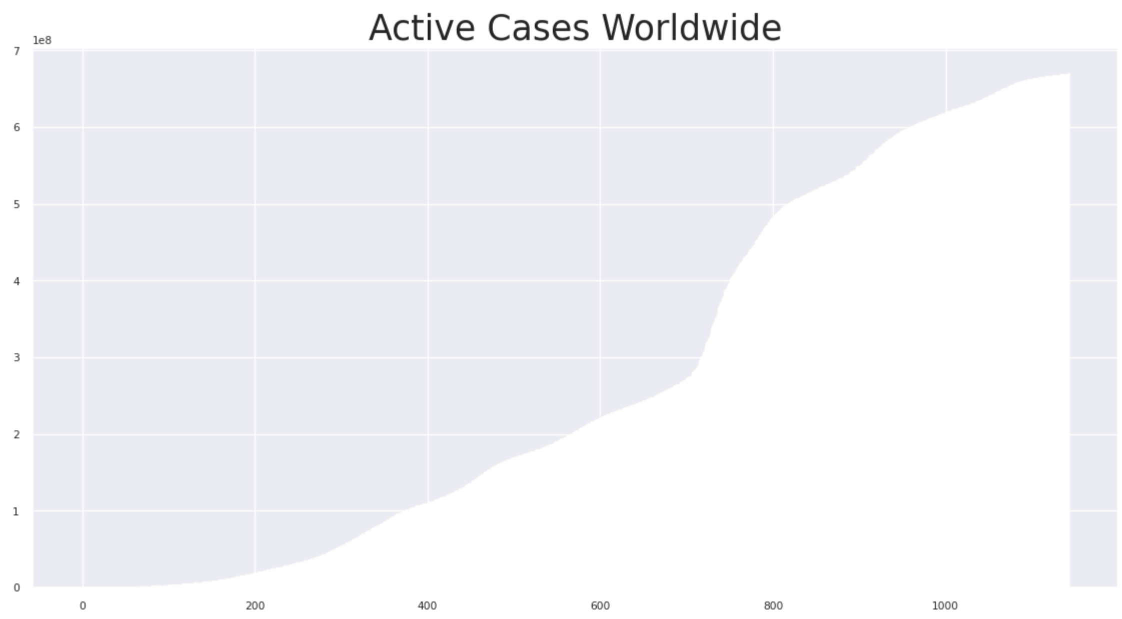
```
days = [ i for i in range(positive.shape[1] - 1) ]

plt.figure(figsize=(14,7))
plt.bar(days,positive_date,color='Blue')
plt.title('Positive Cases Globally',size=25)
plt.show()

plt.figure(figsize=(14,7))
plt.bar(days,mortality_date,color='Red')
plt.title('Mortality Cases Globally',size=25)
plt.show()

plt.figure(figsize=(14,7))
plt.bar(days,active_date,color='Yellow')
plt.title('Active Cases Worldwide',size=25)
plt.show()
```



Positive Cases Globally



Mortality Cases Globally

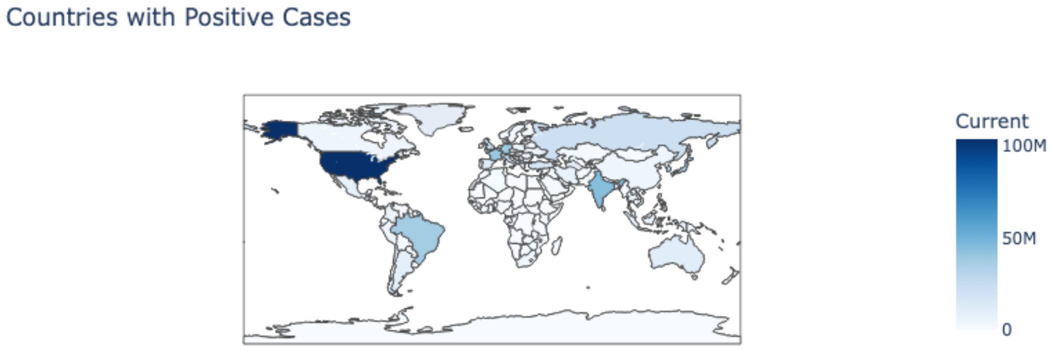


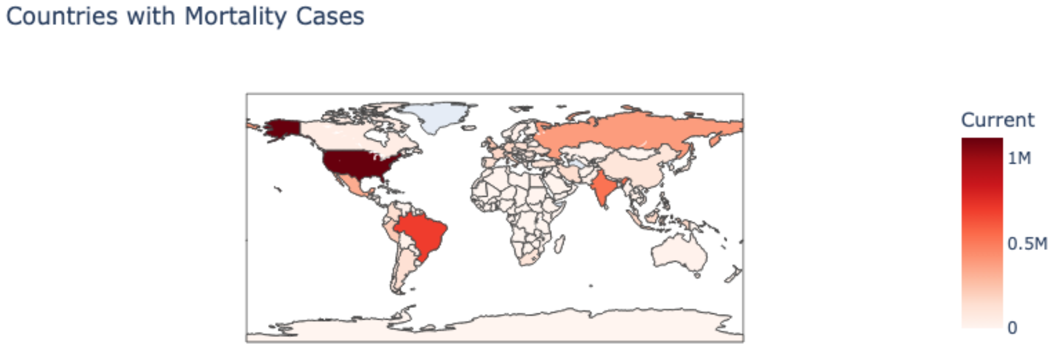
[175]:
```
# Initial results:

## An exponential growth in positive cases was identified on third month from␣
 ↪the outbreak, having a spike after second year.
## There was a gradual increase in mortality rate from second month onwards.
## A similar path was identified with active cases as covid positive.
```

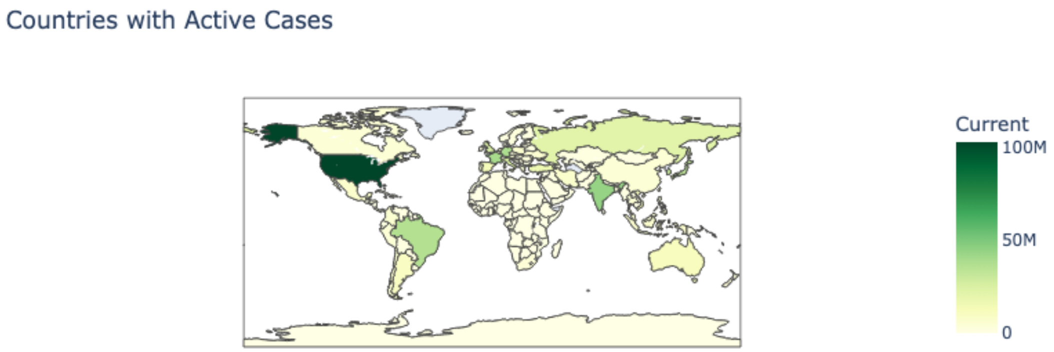
[176]:
```
# The distribution of cases nationwise:
```

[177]:
```
### Positive cases

fig = px.choropleth(positive_data, locations="Country", locationmode='country␣
 ↪names',
                    color=positive_data['Current'], hover_name="Country",
                    title='Countries with Positive Cases',hover_data=['Current'],␣
 ↪color_continuous_scale="blues")
fig.show()

### Mortality cases

fig = px.choropleth(mortality_data, locations="Country", locationmode='country␣
 ↪names',
                    color=mortality_data['Current'], hover_name="Country",
                    title='Countries with Mortality␣
 ↪Cases',hover_data=['Current'], color_continuous_scale="reds")
fig.show()
```

```
### Active cases

fig = px.choropleth(active_data, locations="Country", locationmode='country names',
                    color=active_data['Current'], hover_name="Country",
                    title='Countries with Active Cases',hover_data=['Current'], color_continuous_scale="ylgn")
fig.show()
```







[178]:

```
# Linear Regression
```

[179]:

```
total_positive = np.array(positive_date).reshape(-1,1)
total_mortality = np.array(mortality_date).reshape(-1,1)
total_active = np.array(active_date).reshape(-1,1)
dates = np.array([i for i in range(len(days))]).reshape(-1, 1)
```

[180]:

```
## Linear Graph

def linear_plot(x,y,reg,title):
    plt.figure(figsize=(14,7))
    plt.scatter(x,y,color='blue')
    plt.plot(x,reg)
    plt.title(title)
```

[181]:

```
X_train_positive, X_test_positive, y_train_positive, y_test_positive =␣
 ↪train_test_split(dates[100:], total_positive[100:], test_size=0.14,␣
 ↪shuffle=False)
```

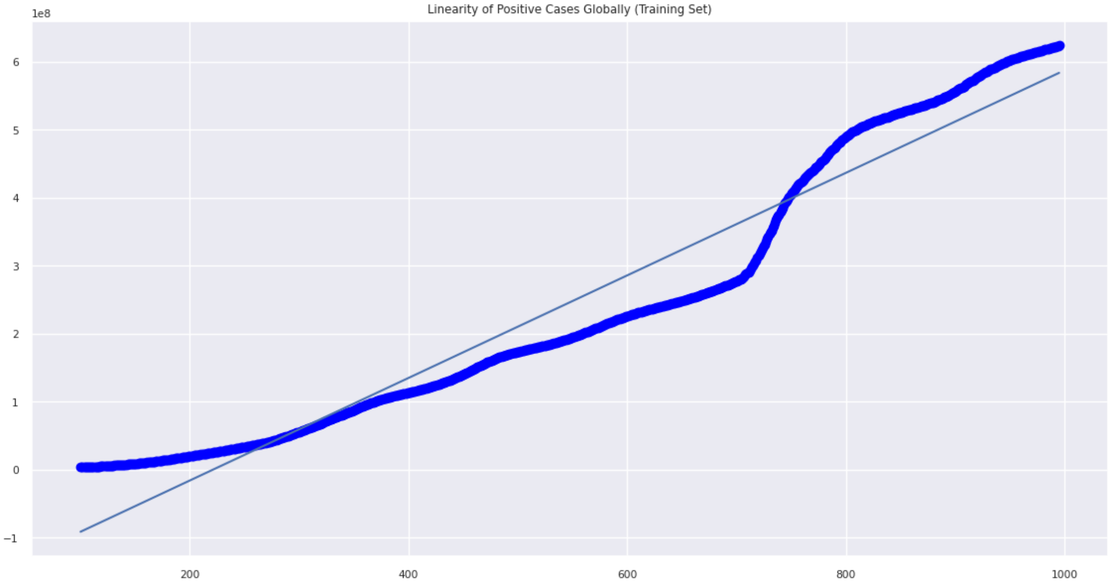
[182]:

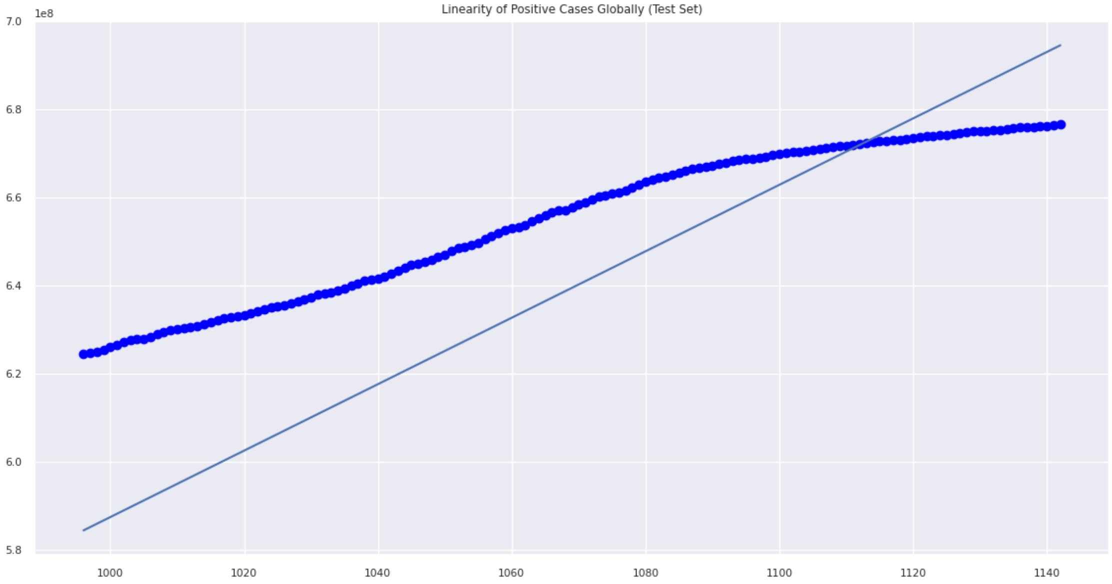
```
reg = LinearRegression()
reg.fit(X_train_positive, y_train_positive);
```

[183]:

```
## Plot trainning set

linear_plot(X_train_positive,y_train_positive,reg.
 ↪predict(X_train_positive),'Linearity of Positive Cases Globally (Training␣
 ↪Set)')


## Plot test set

```

```
linear_plot(X_test_positive,y_test_positive,reg.
 ↪predict(X_test_positive),'Linearity of Positive Cases Globally (Test Set)')
```





[184]:

```
### The test set predictions are not similar as the trainning set predictions.␣
 ↪As the total positive cases iregular curves, polynomial regression model was␣
 ↪approached.
```

[185]:

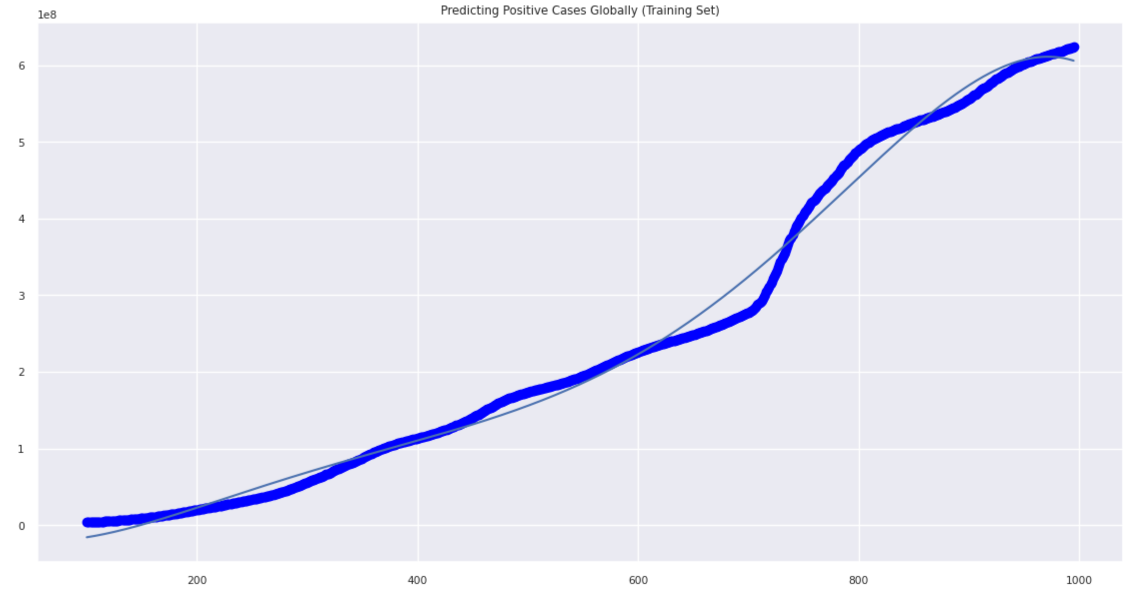
```
# Polynomial Regression
```

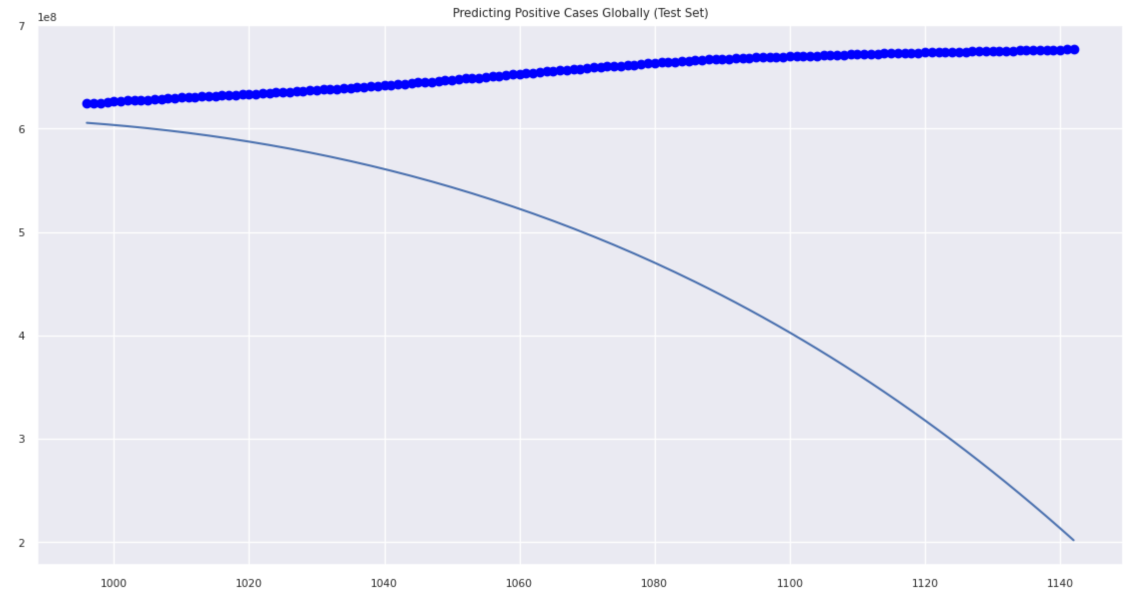
[186]:
```
## Positive Cases

### Data transformation

poly = PolynomialFeatures(degree=5)
poly_X_train_positive = poly.fit_transform(X_train_positive)
poly_X_test_positive = poly.fit_transform(X_test_positive)
```

[187]:
```
### polynomial regression for positive cases

poly_reg = LinearRegression(fit_intercept=False)
poly_reg.fit(poly_X_train_positive, y_train_positive)
```

[187]:
```
LinearRegression(fit_intercept=False)
```

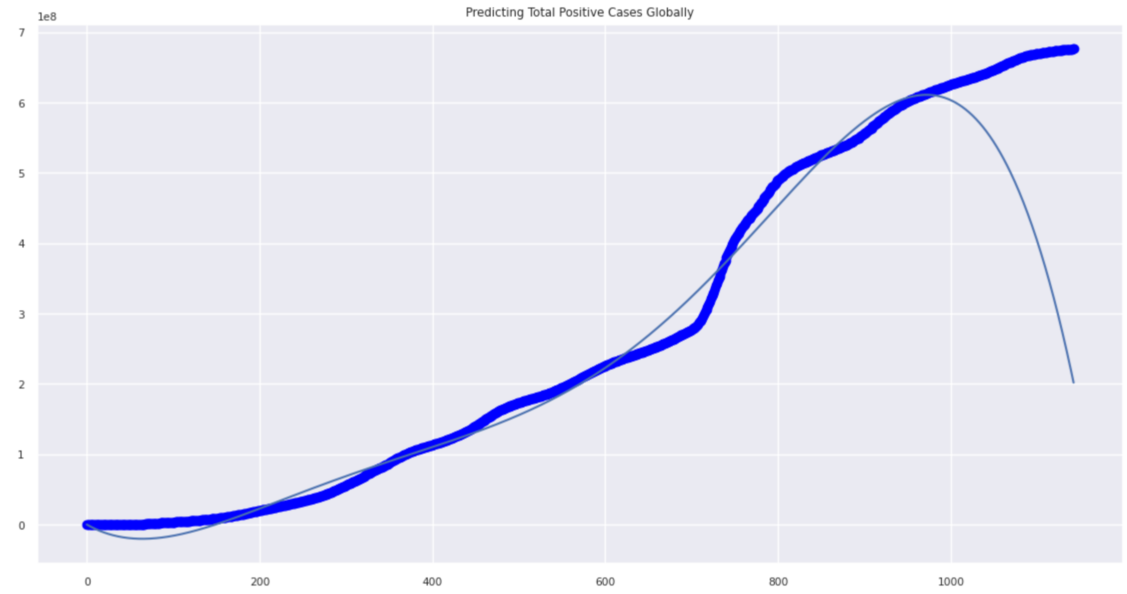
[188]:
```
### Plot training set
linear_plot(X_train_positive,y_train_positive,poly_reg.
  ↪predict(poly_X_train_positive),'Predicting Positive Cases Globally (Training␣
  ↪Set)')

### Plot test set
linear_plot(X_test_positive,y_test_positive,poly_reg.
  ↪predict(poly_X_test_positive),'Predicting Positive Cases Globally (Test␣
  ↪Set)')
```





[189]:
```
### Training set curve showed similar prediction
```

[190]:
```
### Plot of total cases

linear_plot(dates,total_positive,poly_reg.predict(poly.
 ↪fit_transform(dates)),'Predicting Total Positive Cases Globally')
```



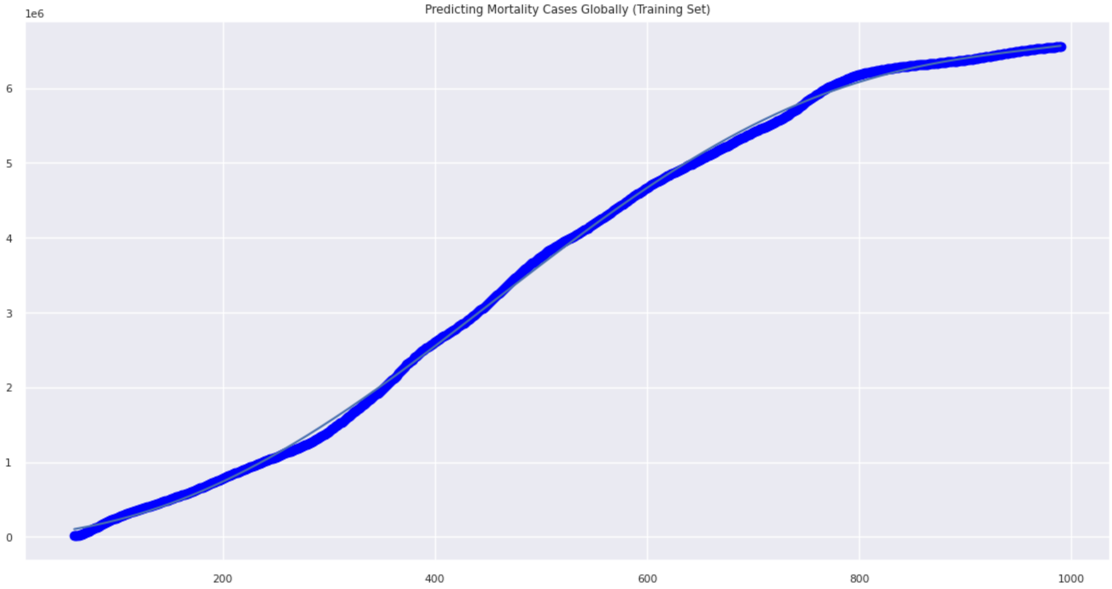
[191]:
```
## Mortality cases
```

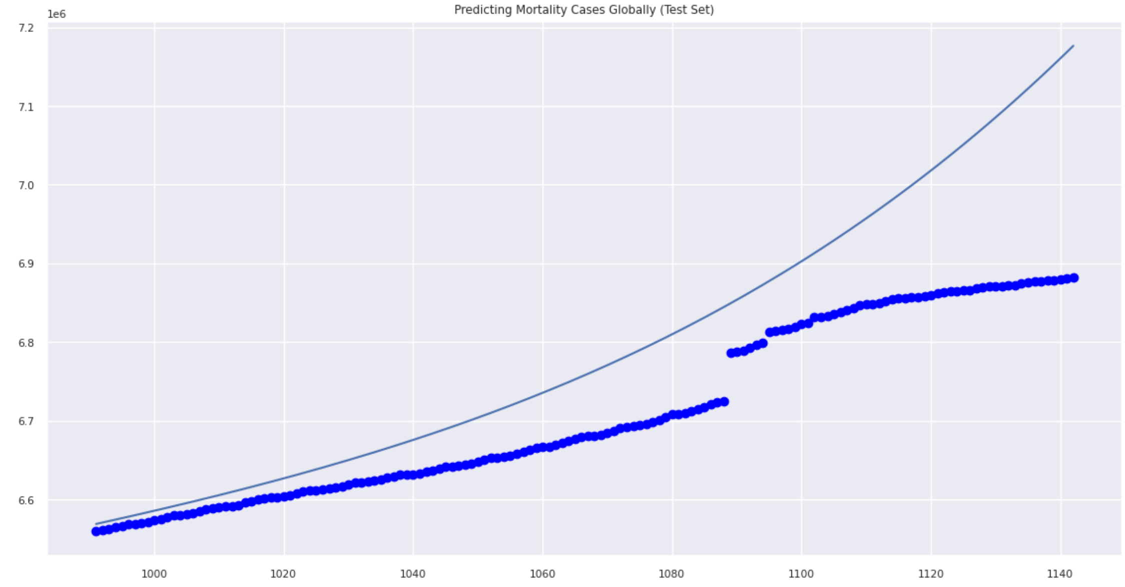
```
[192]: X_train_mortality, X_test_mortality, y_train_mortality, y_test_mortality =␣
        ↪train_test_split(dates[60:], total_mortality[60:], test_size=0.14,␣
        ↪shuffle=False)
```

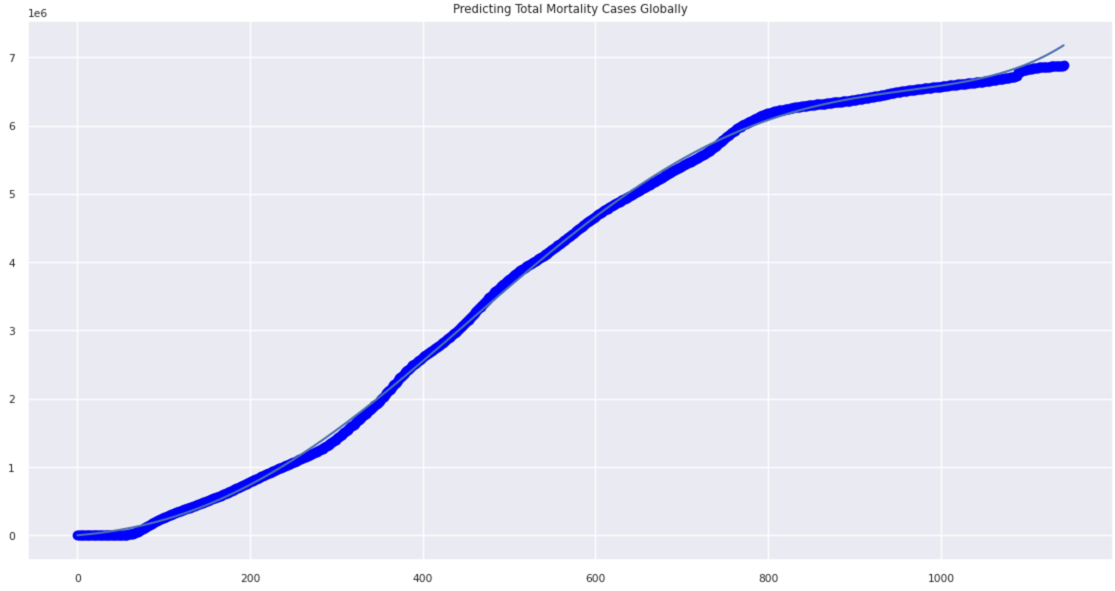
```
[193]: ### transform our data for polynomial regression
       poly = PolynomialFeatures(degree=5)
       poly_X_train_mortality = poly.fit_transform(X_train_mortality)
       poly_X_test_mortality = poly.fit_transform(X_test_mortality)

       ### polynomial regression
       poly_reg = LinearRegression(fit_intercept=False)
       poly_reg.fit(poly_X_train_mortality, y_train_mortality)
```

```
[193]: LinearRegression(fit_intercept=False)
```

```
[194]: # Plot training set
       linear_plot(X_train_mortality,y_train_mortality,poly_reg.
        ↪predict(poly_X_train_mortality),'Predicting Mortality Cases Globally␣
        ↪(Training Set)')

       # Plot test set
       linear_plot(X_test_mortality,y_test_mortality,poly_reg.
        ↪predict(poly_X_test_mortality),'Predicting Mortality Cases Globally (Test␣
        ↪Set)')

       # Plot total cases
       linear_plot(dates,total_mortality,poly_reg.predict(poly.
        ↪fit_transform(dates)),'Predicting Total Mortality Cases Globally')
```







```
[195]: ## The mortality rate predictions showed a similar trend thoughout the duration.
```

```
[ ]: # Result:
     ---
```

```
* The data sets of confirmed, death, and recovered cases comprised 298, 289 and␣
 ↪274 entries of countries with 1147 values describing the nation, region and␣
 ↪cases from 22nd January 2020 to 9th September 2023.
* The total cases identified were 676570149 confirmed, 6881802 deaths and␣
 ↪669688347 recovered.
* The most confirmed cases were observed in US, India, France, Germany, and␣
 ↪Brazil; death cases in US, Brazil, India, Russia and Mexico; recovered cases␣
 ↪in US, India, France, Germany and Brazil.
* Initially, confirmed cases increased monthly for all the countries (US,␣
 ↪India, Australia, UK, Brazil and South Africa).
* A constant rate was identified two years after the first case, which can␣
 ↪result from global regulations under quarantine, safety protocols and␣
 ↪vaccination, except for the United States.
* A similar fashion of death and recovery rates was observed across the five␣
 ↪nations; uniquely, Australia showed a meagre rate with all conditions,␣
 ↪whereas the US had the highest rates.
* An exponential growth in confirmed cases was identified after the third␣
 ↪month, having a spike after the second year, leading to a gradual increase␣
 ↪in death rates globally from the second month onwards.
---
```

[ ]:

```
# Referece
---
1.        This data set is licensed under the Creative Commons Attribution 4.0␣
 ↪International (CC BY 4.0) by the Johns Hopkins University on behalf of its␣
 ↪Center for Systems Science in Engineering. Copyright Johns Hopkins␣
 ↪University 2020.

2.        Attribute the data as the "COVID-19 Data Repository by the Center for␣
 ↪Systems Science and Engineering (CSSE) at Johns Hopkins University" or "JHU␣
 ↪CSSE COVID-19 Data" for short, and the url: https://github.com/
 ↪CSSEGISandData/COVID-19.

3.        For publications that use the data, please cite the following␣
 ↪publication: "Dong E, Du H, Gardner L. An interactive web-based dashboard to␣
 ↪track COVID-19 in real time. Lancet Inf Dis. 20(5):533-534. doi: 10.1016/
 ↪S1473-3099(20)30120-1"


-
```